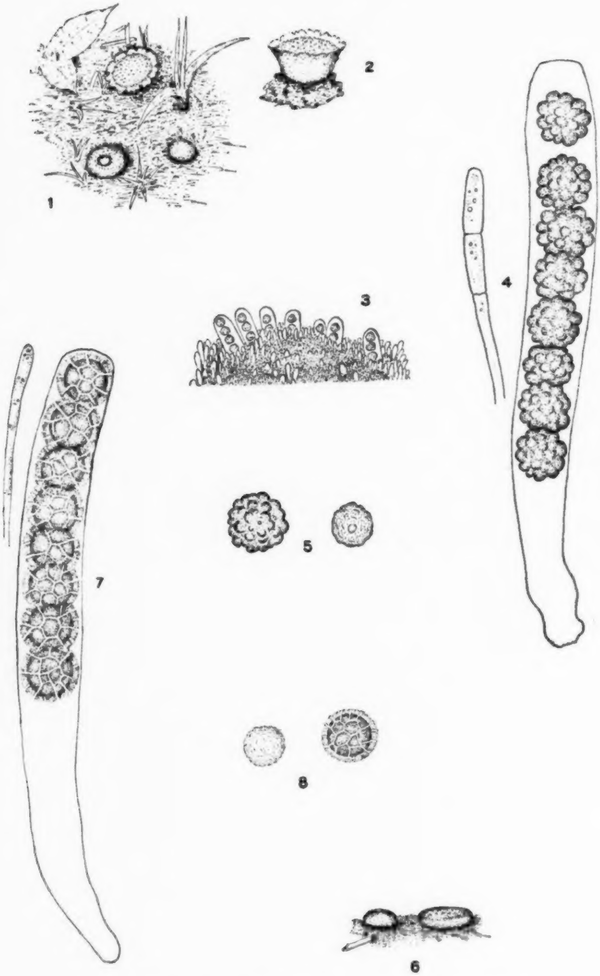

1–5. LAMPROSPORA TUBERCULATA SEAVER
6–8. LAMPROSPORA AREOLATA SEAVER

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THE GENUS LAMPROSPORA, WITH DESCRIPTIONS OF TWO NEW SPECIES

FRED J. SEAVER

(WITH PLATE 57, CONTAINING 8 FIGURES)

The genus *Lamprospora* was founded by De-Notaris in 1864, with *Ascobolus miniatus* Crouan, one of the globose-spored operculate cup-fungi as its monotype.

In 1869 Fuckel published the genus *Crouania* with *Crouania miniata* (Crouan) Fuckel as the type of the genus. This name is untenable, having been previously used for a genus of algae,[1] and in addition is antedated by the above name.

In 1889 the name *Barlaea* was proposed by Saccardo with *Crouania* Fuckel as a synonym. This name is also untenable, having been previously used for a genus of flowering plants.[2] Saccardo discovering this fact, later published the genus *Barlaeina* with *Barlaea* Sacc. as a synonym.

Lamprospora therefore appears to be the proper name to be used for the smaller plants of the globose-spored type of operculate discomycetes, except those which are commonly placed with the Ascobolaceae, through its priority of date and with the additional fact that two of the more recent generic names proposed are untenable for reasons mentioned above.

For several years past the writer has been interested in the col-

[1] Agardh, J. G., Alg. Mar. Med. 83. 1842.

[2] Reichenbach, H. G., Linnaea **41**: 54. 1877.

[Mycologia for January, 1912 (**4**: 1–44), was issued January 6, 1912].

lection and study of these minute but interesting plants and the recent collection of two apparently undescribed species has prompted the writing of the present paper. For the following reasons both the collection and study of the plants of this genus is difficult and unsatisfactory.

1. The plants are often so small that they are easily overlooked and for this reason seldom collected.

2. The descriptions of the known species are so fragmentary that in many cases they do not render the plants recognizable.

3. The type specimens preserved in the ordinary way are of little value since the plants, at best small, become much smaller on drying and are often lost with the crumbling earth on which they usually grow.

These difficulties are partly compensated by the fact that while the plants are very small the spores, as a rule, are unusually large. In addition to their large size they are often sculptured, the nature of the sculpturing furnishing valuable diagnostic characters. The type species of the genus has the spores covered with delicate, shallow reticulations. Other species have the spores marked with deep reticulations, sharp spines, minutely verrucose or coarsely tuberculate. In a number of species the spores are smooth and we must in such cases rely upon other diagnostic characters. In addition to the preservation of plants on the substratum for the study of gross characters in the ordinary way microscopic slides should be preserved, especially in those forms in which the spores furnish diagnostic characters. With careful drawings and descriptions from fresh material and specimens preserved in the above manner the species of the genus should be made recognizable.

The plants of this genus show rather close relationship with some of the Ascobolaceae both in the character of the spores and asci as well as in the protrusion of the asci above the surface of the hymenium, the latter character being the one on which the Ascobolaceae are distinguished from the Pezizaceae. To the writer it seems very doubtful if there is any morphological character by which these two families can be separated. The most natural classification of the true cup-fungi (Pezizales) to my

mind, is that proposed by Boudier,[3] *i. e.,* to separate them into the operculate and non-operculate forms. The former group would include those in which the asci open by an operculum or lid and the latter those in which the asci open by a pore. As pointed out by Boudier these characters are accompanied by numerous others which strongly suggest a natural division. This classification would throw together the Ascobolaceae and Pezizaceae unless some morphological character can be discovered on which they can be distinguished other than that which is commonly used. The occurrence of many of the Ascobolaceae on the dung of animals is a convenient character but there are so many exceptions that this can hardly be relied upon as a characteristic of the family. If the Ascobolaceae are kept distinct on the character usually employed, the protrusion of the asci, at least some of the species of the genus *Lamprospora* should be placed among the Ascobolaceae. Whether the entire genus should be transferred I am uncertain. To my mind the most natural thing would be to ignore the family distinctions of the Ascobolaceae and Pezizaceae and key out the genera regardless of this family distinction.

LAMPROSPORA De-Not. Comm. Critt. Ital. **1**: 388. 1864

Crouania Fuckel, Symb. Myc. 320. 1869.

Barlaea Sacc. Syll. Fung. **8**: 111. 1889.

Barlaeina Sacc. Syll. Fung. **14**: 30. 1899.

Plants small, scarcely exceeding 5 mm. in diameter, concave, plane or slightly convex, usually bright-colored or more rarely pallid, fleshy, hymenium often roughened by the protruding asci; asci 8-spored, operculate; spores comparatively large, globose, at first smooth, at maturity often sculptured, verrucose, echinulate, reticulate or tuberculate or permanently smooth, hyaline; paraphyses numerous and usually clavate.

Type species, *Ascobolus miniatus* Crouan.

Lamprospora tuberculata sp. nov.

Plants small, 0.5–1 mm. in diameter, hymenium gradually expanding, at maturity plane or slightly convex, bordered by a

[3] Boudier, E., On the importance that should be attached to the dehiscence of asci in the classification of the discomycetes. Grevillea **8**: 45–48. 1879.

delicate fringe, pale orange; hymenium roughened by the protruding asci; asci cylindric, operculate, 15–18μ in diameter; spores globose, at first smooth with a large oil-drop, gradually becoming roughened, at maturity coarsely tuberculate, about 16μ in diameter, hyaline; paraphyses clavate (*pl. 57, f. 1–5*).

On damp soil among moss in open places; type collected near Yonkers, New York. The same species has been collected by the writer in New Jersey and by Mr. B. O. Dodge in Virginia.

Lamprospora areolata sp. nov.

Plants small, 0.5–1 mm. in diameter, at first globose opening rather irregularly, at maturity with the hymenium plane or slightly convex, more or less roughened by the ends of the asci, bright red; asci cylindric, 15–18μ in diameter, 8-spored; spores globose, at first smooth, with a large oil-drop, becoming rough at maturity deeply areolate, about 16μ in diameter; paraphyses clavate (*pl. 57, f. 6–8*).

On soil among moss in a beaten path in woods near Yonkers, New York.

Both the plants and the spores are similar to *Humaria calospora* Quél. as figured by Boudier in Ic. Myc. *pl. 400,* except that the spores are perfectly globose instead of ellipsoid.

CULTURES OF UREDINEAE IN 1911[1]

J. C. Arthur

The present article is the twelfth of a series of reports[2] by the writer upon the culture of plant rusts, extending through thirteen consecutive years. The preceding report for the year 1910, published in Mycologia for January, 1912, contained an unfortunate slip of the pen in the heading of a paragraph at the middle of page 13, where "*Grossulariae* (Schum.) Lagerh." should read *albiperidia* Arth. With this change, the discussion which follows reads correctly. The same error occurs on page 30, twelfth line from the bottom.

The very large majority of the sowings for each year are made during the months of April and May. Hot weather is inimical to the work, except for a few species. Throughout the year 1911 unusual high temperature prevailed; after the first week in May the thermometer ranged above 80° F. during the middle of the day for the remainder of the cultural season. Owing to an unfortunate delay in securing an assistant to prosecute the work, the first sowings were not made until April 19, and the work was scarcely well under way before the hot days began, making it nearly impossible to obtain germination of the spores, or in case of germination to obtain infection of the hosts.

The work of the season was conducted by Mr. Earl A. Trager, a junior high school student of South Bend, Ind., who was recommended by Miss Clara Cunningham, teacher of the natural sciences in the South Bend High School. Mr. Trager conducted the work admirably. He furthermore showed capacity for mastering the technique and for handling the problems involved which compared favorably with that of his more mature and

[1] Presented before the Botanical Society of America at the Washington meeting, December 27, 1911.

[2] See Bot. Gaz. **29**: 268–276; **35**: 10–23; Jour. Myc. **8**: 51–56; **10**: 8–21; **11**: 50–67; **12**: 11–27; **13**: 189–205; **14**: 7–26; Mycol. **1**: 225–256; **2**: 213–240; and **4**: 7–33. 1912.

experienced predecessors. The paucity of results is wholly ascribable to the lateness in beginning the work and to the unseasonable weather.

Only one direct excursion was made to supply material for this year's cultures. Early in March the writer, accompanied by Mr. Ray Stretch, a graduate of the Lafayette High School, who rendered efficient service and proved a keen observer, visited the region bodering the Mississippi Sound from Ocean Springs to Pass Christian, Miss., well known from the thorough field work and numerous publications of Professor S. M. Tracy, whose home is at Biloxi, between the two places mentioned. The special object in view was to secure material of *Gymnosporangium bermudianum,* the only autoecious species known belonging to this genus, both for culture and for morphological work. Hope was also entertained that fresh material of species of *Peridermium,* with field observations to assist in culture work, might be secured. The region was found to possess the fewest rusts, both in number of species and in their abundance, of any section yet visited for observational purposes.

Upon request a visit to Newfield, N. J., was made by Dr. Frank D. Kern, studying during the collegiate year at Columbia University, New York, accompanied by Mr. B. O. Dodge, a graduate student of the same institution. The object was to secure material of several species of *Gymnosporangium* for cultures. Newfield was chosen, as it was for many years the home of Mr. J. B. Ellis, and his collections show a number of hitherto poorly understood species, whose aecia are still unknown. Probably the most interesting of these is a small foliicolous form on the white cedar, recently described as *G. fraternum* Kern. A note found in the Ellis collection at the New York Botanical Garden gave evidence that it was common in a certain swamp twenty-five years ago. The particular spot was found, and the fungus secured. One day was spent in this vicinity, and seven species of *Gymnosporangium* were collected. Among these were *G. Ellisii,* whose aecial stage is suspected to be the rare *Roestelia hyalina,* and the recently named *G. effusum.* The last is a large form on branches, very destructive to the red cedar, and yet never issued in exsiccati. It is the only one collected on this trip from which infection was obtained.

An extended excursion, but too late for the season's cultures, was made by the writer and Dr. Frank D. Kern during August and September to the foothills of Colorado, between Boulder and Pueblo, and to some extent in the adjacent mountains. This is the richest rust flora, both in species and frequency of occurrence, yet encountered. The dryness of the atmosphere, which promotes the growth of the rust on the individual hosts, while checking the spread from plant to plant, makes the region an exceptionally fine one for field study of relationships between the alternate stages of heteroecious species. Our work was enormously promoted by assistance from Mr. E. Bethel, of Denver, whose exact, enthusiastic, and prolonged observations over the whole region visited cannot be too highly commended. The freedom with which he turned over for our use his most important discoveries and conclusions must unfortunately be inadequately repaid. It was due to his assistance that this excursion proved the richest in results by far of any yet undertaken, results that are only slightly reflected in this report, but have paved the way for important cultures in 1912.

On the eleventh of November, after a day of summer heat, a hurricane did great injury to the conservatory and greenhouse of the Experiment Station, in which many plants for the next season's experiments were growing. At about nine o'clock in the evening a large part of the glass in these houses, and in the offices and laboratories of the department of botany, was broken in by the violence of the wind. The heavy rain which was falling soon turned to snow, and the temperature dropped to many degrees below freezing. When the damage was detected at about eight o'clock the next morning, the plants were largely beyond recovery.

Hearty thanks are due to the following persons who contributed material for study: Mr. E. Bethel, Denver, Colo., heading the list with 87 collections; Messrs. E. W. Olive, Brookings, S. D., J. M. Bates, Red Cloud, Neb., J. Dearness, London, Ont., and W. P. Fraser, Pictou, Nova Scotia, each sent between 10 and 30 collections, while much smaller numbers were sent by Messrs. E. Bartholomew, Stockton, Kans., C. F. Baker, Claremont, Calif., J. F. Brenckle, Kulm, N. D., J. C. Blumer, Tucson,

Ariz., H. S. Coe, Ames, Iowa, H. M. Jennison, Crawfordsville, Ind., S. Kusano, Tokio, Japan, E. F. Smith, Hannaford, N. D., E. M. Wilcox, Lincoln, Neb., J. J. Wolf, Durham, N. C., and F. Vasku, Oberlin, Ohio. Seeds and living plants were also sent by a number of botanists to provide host plants of native species required in the work. To all these and to others who aided in the work of the year grateful acknowledgment is due and is hereby extended. The investigations were carried out under the auspices of the Indiana Experiment Station, and financed from the Adams fund.

During the present season 193 collections of material with resting spores and 37 collections with active spores were employed, from which 691 drop cultures were made to test the germinating condition of the spores. Out of the 193 collections with resting spores 156 failed to germinate, leaving 37 collections available for experimental tests. Altogether about 235 sowings were made and 32 infections obtained. All but three sowings were made on plants growing in pots in the greenhouse. The most important conclusions derived from a study of the results are given in the following paragraphs.

NEGATIVE RESULTS.—It has been customary in these reports to record sowings with germinating spores when no infections were obtained, to serve as a guide in selecting hosts for future attempts. This year only a few instances will be given, as all sowings made after the heated term began, May 8, are deemed too uncertain to be of value.

1. PUCCINIA TOSTA Arth., on *Sporobolus asperifolius* (Nees & Meyen) Thurb., collected at Denver Colo., by Mr. E. Bethel, was sown April 19, on *Atriplex confertifolia* and *Malvastrum coccineum,* with no infection. The day following a collection with same data from Delta, Colo., was sown on *Aesculus glabra* and *Xanthoxylum americanum,* and again, May 10, on ten other hosts, with no infection.

The resemblance of this rust and of its host to that of *Puccinia subnitens* Diet., on *Distichlis spicata,* is very marked, as seen in the field. The two species grow under the same conditions, often intermixed, and might be expected to have the same aecial

hosts, a possibility barely touched by the present attempt at culture.

2. PUCCINIA SCHEDONNARDI K. & S., on *Schedonnardus paniculatus* (Nutt.) Trel., collected at Stockton, Kans., by Mr. E. Bartholomew, was sown April 19, on *Aesculus glabra, Xanthoxylum americanum, Hydrophyllum capitatum, Sidalcea oregana, Callirrhoe involucrata,* and *Onagra pallida,* with no infection. Similar material in former years was sown on twenty-eight other species of hosts.[3]

3. GYMNOCONIA INTERSTITIALIS (Schl.) Lagerh. No attempts have been made, so far as the writer knows, to propagate any species of rust by means of its pycniospores, except one made by Dr. Frank D. Kern in 1910, and not heretofore reported. He sowed pycniospores from *Amelanchier erecta,* belonging to *Gymnosporangium clavariaeforme,* upon young leaves of *A. erecta* by pricking and otherwise mutilating the epidermis, but without results. It is well known that the growth of such spores soon ceases in a liquid culture the same as with any other rust spores, only sooner, as they are much smaller and contain less nutriment. But it has not been shown that they will not form a mycelium when suitably placed upon or within the tissues of a host plant. The prominent and abundant pycnia of the blackberry rust, which mature in advance of the aecia, seem especially favorable for such a trial. Pycniospores from *Rubus allegheniensis* taken when perfectly fresh were sown May 9 on young leaves of two different plants of the same species, which were well established in pots. The spores were not only placed on the surface of the partly grown leaves, but were also pricked into the tissues in places with a needle. This was done to imitate the probable dispersion of such spores by insects, for which the nectar secreted by the sori may have an attraction. No infection was obtained. Neither in this attempted culture nor in that by Dr. Kern was any examination made to ascertain what growth the pycniospores may have made.

SUCCESSFUL CULTURES SUPPLEMENTING PREVIOUS WORK.—The facts derived by growing the following species of rusts supple-

[3] See Bot. Gaz. **35**: 11. 1903; Jour. Myc. **13**: 193. 1907; **14**: 11. 1908; Mycol. **1**: 231. 1909; and **4**: 10. 1912.

ment those obtained from previous cultures in this series or from cultures recorded by other American or European investigators.

1. PUCCINIA PECKII (DeT.) Kellerm., on *Carex lanuginosa* Michx., collected at Red Cloud, Neb., by Rev. J. M. Bates, was sown May 20 on *Onagra biennis* and *Meriolix serrulata,* with no infection on the latter, but with abundant pycnia on the former May 29, and aecia June 1.[4] Similar cultures on *Onagra biennis* were made from undetermined species of *Carex* collected by Mr. E. Bethel, at Denver, Colo., and by Dr. J. F. Brenckle, at Kulm. N. D.

2. PUCCINIA ANGUSTATA Peck, on *Scirpus cyperinus* (L.) Kunth, collected at London, Ont., by Mr. J. Dearness, was sown May 25 on *Lycopus americanus,* giving rise to pycnia first seen June 3, and aecia June 5.[5]

3. PUCCINIA PHRAGMITIS (Schum.) Körn., on *Phragmites communis* Trin., collected at Cowles, Neb., by Rev. J. M. Bates, was sown May 9 on *Rumex crispus,* giving rise to abundant pycnia and aecia first observed May 23.[6]

4. PUCCINIA CINEREA Arth., on *Puccinellia airoides* (Nutt.) Wats. & Coult., collected at Lewis Station, Colo., by Mr. E. Bethel, was sown May 10 on *Oxygraphis Cymbalaria,* giving rise to pycnia May 16, and an abundance of aecia May 20.[7]

5. PUCCINIA SUBNITENS Diet., on *Distichlis spicata* (L.) Greene, collected at Lewis Station, Colo., by Mr. E. Bethel, was sown May 2, on *Sarcobatus vermiculatus, Monolepis Nuttalliana, Cleome spinosa, Atriplex hastata,* and *Chenopodium album,* with no infection on the first two, but with numerous pycnia on the others, appearing May 11, 12 and 16, respectively, followed by aecia on the *Cleome* and *Atriplex,* on both appearing May 15.[8]

[4] For previous cultures see Bot. Gaz. **35**: 13. 1903; Jour. Myc. **8**: 52. 1902; **11**: 58. 1905; **12**: 15. 1906; **13**: 195. 1907; Mycol. **1**: 233. 1909; **2**: 222. 1910; and **4**: 15. 1912.

[5] For previous cultures see Bot. Gaz. **29**: 273. 1900; Jour. Myc. **8**: 53. 1902; **11**: 58. 1905; **13**: 196. 1907; **14**: 14. 1908; Mycol. **1**: 234. 1909; and **4**: 17. 1912.

[6] For previous cultures see Bot. Gaz. **29**: 269. 1900; Jour. Myc. **9**: 220. 1903; **14**: 15. 1908; and Mycol. **2**: 225. 1910.

[7] For a previous similar culture see Mycol. **1**: 246. 1909.

[8] For previous cultures see Bot. Gaz. **35**: 19. 1903; Jour. Myc. **11**: 54. 1905; **12**: 16. 1906; **13**: 197. 1907; **14**: 15. 1908; Mycol. **1**: 234. 1909; **2**: 225. 1910; and **4**: 18. 1912.

6. UROMYCES PECKIANUS Farl., on *Distichlis spicata* (L.) Greene, obtained in the field March 29, 1911, at Pictou, Nova Scotia, by Professor W. P. Fraser, was sown April 19 on *Tissa canadensis* and *Lepidium virginicum*, with no infection. Another collection with same data but obtained in the field April 13, 1911, was sown on *Bursa Bursa-pastoris, Lepidium virginicum, Corydalis montanum, Tissa canadensis, Cleome spinosa*, and *Atriplex hastata*, with no infection except on the last, which showed numerous pycnia May 16, and an abundance of aecia May 22. Still another collection with same data but obtained in the field April 27, 1911, was sown May 5 on *Chenopodium album* and on the same six hosts as the last, with infection only on *Atriplex*, showing pycnia May 17, and aecia May 29, both in abundance.

A former attempt at cultures with this species proved futile,[9] but Professor Fraser[10] met with better success in cultures made by himself during the same season of 1910. He was able to abundantly infect both *Atriplex hastata* and *Chenopodium album* from teliospores on *Distichlis spicata*. Material from his cultures was most generously sent to the writer. Since then he has sent material of his more extensive and important cultures of 1911, which need not be specifically mentioned here, although they strengthen the conclusions about to be stated.

A careful morphological study of herbarium material, both as collected in the field and as grown from cultures, shows no appreciable difference in the gross or microscopical characters between the several stages of *Puccinia subnitens* Diet. and *Uromyces Peckianus* Farl., except in one particular—the unilocular or bilocular condition of the teliospore. When the teliospore is two-celled, as in the *Puccinia*, it is correspondingly longer than, but essentially the same otherwise as the one-celled teliospore, found in the *Uromyces*. The aecia in their peridial cells and aeciospores, and the uredinia in their appearance and in their urediniospores, when taken by themselves are indistinguishable. The only character with which to separate the so-called two species is the presence or absence of a septum in the teliospore.

Both the *Puccinia* and the *Uromyces* show marked racial tendencies in the selection of aecial hosts, seemingly correlated with

[9] See Mycol. 4: 12. 1912.

[10] Mycol. 3: 72–74. 1911.

geographical position, but more information is needed regarding the races of the *Uromyces* before a full comparison can be instituted. Whether the aecia of the *Uromyces* ever occur upon any family other than the *Chenopodiaceae,* as do those of the *Puccinia,* yet remains uncertain, but it is confidently expected that such will be the case. In any event there is every reason, except that of nomenclatorial expediency, to consider *Puccinia subnitens* and *Uromyces Peckianus* telial races of one and the same species which in turn may be separable into geographical races in accordance with their selection of aecial hosts.

7. UROMYCES MEDICAGINIS Pass. The urediniospores from plants of *Medicago sativa* L., carried over the winter in the greenhouse, were sown March 8 on *Medicago sativa, Trifolium pratense, T. medium,* and *T. repens,* producing infection only on the first, uredinia showing March 22. A similar set of sowings was made April 28 on other plants of the same four hosts, with similar result, only the *Medicago* being infected, showing uredinia May 12. The work of 1910 is thus confirmed.[11]

8. GYMNOSPORANGIUM NIDUS-AVIS Thax., on *Juniperus virginiana* L., was sent by Dr. Frank D. Kern from Newfield, N. J., and sown May 4 on leaves of *Cydonia vulgaris, Malus coronaria, Amelanchier erecta,* and also on the fruit of the last. The only infection was on the fruit of the *Amelanchier,* showing numerous pycnia May 12, and aecia in great abundance May 24. Another collection on the same host sent by Professor E. Mead Wilcox from Lincoln, Neb., was sown May 11 on leaves of the same three hosts, with infection only on the *Malus,* giving pycnia June 2, but the leaves dying before aecia formed.[12]

9. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC., on *Juniperus sibirica* Burgsd., was sent by Mr. E. Bethel from Lake Eldora, Colo., and sown May 25 in the open orchard on fruits of pears and apples, and in the greenhouse on leaves of *Cydonia vulgaris* and fruits of *Amelanchier erecta,* with no results except on fruits of *Amelanchier,* giving abundant pycnia May 31, and very abundant aecia June 15.[13]

[11] See Mycol. **4**: 24. 1912.

[12] For previous cultures see Jour. Myc. **2**: 230. 1910; and **4**: 25. 1912.

[13] For previous cultures see Jour. Myc. **14**: 18. 1908; Mycol. **1**: 239. 1909; and **4**: 24. 1912.

10. GYMNOSPORANGIUM INCONSPICUUM Kern, on *Juniperus utahensis* (Engelm.) Lemmon, sent by Mr. E. Bethel from Paonia, Colo., was sown April 7 on leaves of *Amelanchier erecta* and of *A. vulgaris*, with infection only on the latter, showing pycnia April 24, but not maturing aecia.[14]

11. GYMNOSPORANGIUM LIBOCEDRI (P. Henn.) Kern, on *Libocedrus decurrens* Torr., sent by an unknown correspondent, was sown April 17 on *Amelanchier vulgaris, Crataegus tomentosa, C. cerronis,* and *Sorbus aucuparia,* with no infection on the last, but pycnia showing on the other hosts April 25, 26 and 28 respectively, and abundant aecia on the *Amelanchier,* showing May 16.[15]

12. GYMNOSPORANGIUM JUNIPERINUM (L.) Mart., on *Juniperus sibirica* Burgsd., sent by Mr. E. Bethel from Palmer Lake, Colo., was sown April 26 on *Sorbus aucuparia,* without producing infection. It was again sown May 5 on *S. americana,* and produced pycnia May 20 in abundance, but did not develop aecia.

The species has not been cultivated before from American material. The first cultures were made in Europe by Robert Hartig[16] about 1882 at Munich, and the species named *G. tremelloides,* from its conspicuous telia. The Linnaean name appears to have been transferred by Oersted in 1866 to a much less conspicuous form, as pointed out by Kern,[17] but it seems best now to follow the original usage. The galls used in the present culture were on small branches and about one centimeter across.

13. COLEOSPORIUM VERNONIAE B. & C. A collection of *Peridermium carneum* Bosc, on *Pinus taeda* L., collected by Mr. Ray Stretch and the writer at Mississippi City, Miss., was sown March 6 on *Laciniaria scariosa* and *Vernonia gigantea,* with infection only on the latter, uredinia showing March 22. Three other collections on *Pinus taeda* L., made by the same persons at Biloxi, Miss., were each sown March 8 on *Laciniaria scariosa* and *L. punctata,* with no infection. The results confirm the work of 1910.[18]

[14] For previous cultures on fruit of *Amelanchier* see Jour. Myc. **14**: 24. 1908.

[15] For previous cultures see Mycol. **1**: 252. 1909.

[16] Hartig, Lehrb. Baum-Kr. 133. 1882.

[17] Science **27**: 930. 1908; Bull. Torrey Club **35**: 499. 1908; and Bull. N. Y. Bot. Gard. **7**: 458. 1911.

[18] See Mycol. **4**: 29. 1912.

14. MELAMPSORA ALBERTENSIS Arth., on *Populus tremuloides* Michx., from Palmer Lake, Colo., sent by Mr. E. Bethel, was sown April 20 on *Larix laricina, Ribes Cynosbati* and *Pseudotsuga mucronata,* with infection only on the last, showing pycnia in abundance May 4, and aecia May 9.[19] On our excursion to Colorado in September Dr. Kern and the writer in company with Mr. Bethel observed great areas of the mountain sides covered with the yellowed foliage of *P. tremuloides,* almost every leaf of which showed uredinia and telia of this rust. It seems remarkable there should be so few collections of it in herbaria, and also of its aecia on *Pseudotsuga.*

15. MELAMPSORELLA ELATINA (A. & S.) Arth. Part of a large witches' broom of *Aecidium elatinum* A. & S., on *Abies lasiocarpa* Nutt., was sent by Mr. E. Bethel from Lake Eldora, Colo., 9,000 feet altitude, and sown August 8 on *Cerastium oreophilum,* giving an exceedingly abundant infection of uredinia, first recorded on September 7. This is the first culture of the species with American material. In Europe cultures with aeciospores have been made by von Tubeuf,[20] Klebahn,[21] and Ed. Fischer,[22] and indications of races have been found. This is an interesting species of rust from the unusual fact of both phases having perennial mycelium.

SUCCESSFUL CULTURES REPORTED NOW FOR THE FIRST TIME.—The following species have never before been cultivated, in America or elsewhere, so far as the writer knows. It is much to be regretted that some of the species could not be brought to full development, but although the results are in part imperfect, they represent most important additions to previous knowledge.

1. PUCCINIA LYGODESMIAE Ellis & Ev., on wintered-over stems of *Lygodesmia juncea* (Pursh) D. Don, collected April 6, 1911, by Mr. E. Bartholomew, at Stockton, Kans., was sown on plants

[19] For previous cultures see Mycol. **4**: 29. 1912.

[20] Deuts. Bot. Ges. **19**: 433. 1901; Arb. Biol. Abth. Land.-Forstw. Kais. Gesundh. **2**: 368.

[21] Jahr. Wiss. Bot. **35**: 699. 1901; Zeits. Pfl.-Kr. **12**: 139. 1902; and Jahr. Hamb. Wiss. Anst. **20**[3]: 31. 1902.

[22] Ber. Deut. Bot. Ges. **19**: 397. 1901; Zeits. Pfl.-Kr. **11**: 321. 1901; and **12**: 193. 1902.

of the same species April 19, and characteristic telia were observed May 3, without being preceded by pycnia or other spore-forms. The species clearly produces but the one form of spore in its life cycle. The aecia often found on this host are undoubtedly heteroecious.

2. AECIDIUM MONOICUM Peck, on *Arabis* sp. Living plants of some smooth leaved species of *Arabis* bearing aecia were sent by Mr. E. Bethel from Boulder, Colo., 5,000 feet altitude, and arranged May 9 over plants of *Koeleria cristata, Stipa viridula,* and *Trisetum subspicatum,* followed by infection only on the last, uredinia and telia being first observed June 1. Similar plants bearing aecia were also sent by Mr. Bethel from Lake Eldora, Colo., 9,000 feet altitude, and placed over plants of *Koeleria cristata* and *Trisetum majus,* followed by infection on the latter only, uredinia and telia being first observed July 24.

The results of the cultures appear unequivocal. The aecia used belong to a form on *Arabis,* and probably also on related genera, very common throughout the Rocky mountain region, which infests the whole plant and usually prevents it from flowering, consequently the determination of hosts is usually difficult and often impossible. Whether all collections labelled *Aecidium monoicum* Peck belong here may be left to future examination, but most of them doubtless do so, although there may be races going to different species of grasses. A bright yellow form on *Cheiranthus Menziesii* from Nevada was named *Aecidium auriellum* by Mr. Peck, and may be identical with the *Arabis* forms, as the difference in color appears to be incidental.

The telial phase has passed under the name *Puccinia Trisceti* Erikss., a name which belongs to a species with covered telia, that has not with certainty been found in America. The rust with similar naked telia on *Koeleria* and *Stipa, Puccinia Stipae* Arth., is almost identical in morphological characters, but it forms the curious *Aecidium sclerothecioides* E. & E. on composites. There is, moreover, an adaptive distinction—the *Trisetum* form is capable of germination as soon as the teliospores are mature, while in *P. Stipae* the teliospores require a period of rest, and first show their viable character the following spring. Teliospores from the first of the above recorded cultures were tested

in drop culture, and gave abundant and vigorous germination after twelve hours. Sowings were at once made June 29 on two plants of *Arabis* in the rosette stage, grown from seed sent by Mr. Bethel from Colorado. One plant flowered later and showed no evidence of infection. The other plant gradually developed numerous lateral buds, forming a compact mass of small rosettes. This rather abnormal development seems to indicate a probable infection, but the proof must await the elongation of the stems at flowering time next spring.

The credit for detecting the probable connection of these aecial and telial forms is to be shared by Mr. A. O. Garrett and Mr. E. Bethel. On packet 75 of the Fungi Utahensis, *Aecidium monoicum* on *Arabis Drummondii,* Mr. Garrett adds the note, "apparently connected with a rust on *Trisetum subspicatum.*" This collection was made July 22, 1905, and in a letter dated April 30, 1906, he writes: "On July 22 I made a collection of aecidia on *Arabis Drummondii.* The plants were in an open place on the mountain side between spruce timber on either side. On August 21 I returned to the spot to hunt for the alternate form of the *A. monoicum.* Upon reaching the locality I found a plant of *Trisetum subspicatum,* and on it I found teleutospores [distributed in Fungi Utahensis *194*]. Immediately next to it I found a dried up plant of *A. Drummondii* with abundant aecidia. Looking further, I found that wherever I found the III, I found I, although in a few cases I found I without running across III." It should be borne in mind that these observations were made in the arid region of the Rocky mountains, where juxtaposition is more significant than in more humid regions. Mr. Bethel made similar observations at various times in Colorado, and is, moreover, convinced from his field studies that the same species of rust occurs on *Koeleria* and *Stipa.* This may be true, and collections in the herbarium seem to justify the opinion, at least for *Koeleria,* but cultures are yet wanting, material for which should be gathered in late summer or autumn, and not in spring. In a letter dated April 9, 1911, Mr. Bethel makes the significant statement: "The *Koeleria* and *Trisetum* rusts have a strange way of disappearing. It is almost impossible to find them in the spring. I brought home plants of both *Koeleria* and

Trisetum last fall which were very badly rusted, and planted in the garden. However, this spring I can see the telia on only one leaf, and that is the *Trisetum*." Even the rust on the one leaf may have been another species. The evanescent character of this species corresponds to that of *Puccinia Eatoniae* Arth., having aecia on *Ranunculus abortivus* from a diffused mycelium and appearing over the whole surface of the leaf early in spring.

As the rust is now for the first time clearly recognized, it is herewith distinctively named and characterized.

Puccinia monoica (Peck) n. nom. (*Aecidium monoicum* Peck, Bot Gaz. **4**: 230. 1879.)

O. Pycnia amphigenous, thickly scattered over large areas, preceding or among the aecia, honey-yellow becoming brownish, sub-epidermal, flattened-globose, 90–160μ in diameter by 60–112μ high; ostiolar filaments 30–90μ long.

I. Aecia chiefly hypophyllous, evenly and thickly scattered, usually occupying the whole under surfaces of the leaves, cupulate or short cylindrical, 0.3–0.4 mm. in diameter; peridium whitish, the margin erect or spreading, somewhat lacerate, the peridial cells rhomboidal, 29–34μ long, the outer wall 7–10μ thick, striate, the inner wall 3–3.5μ thick, verrucose; aeciospores globoid, 15–23 by 18–25μ, the wall colorless, 1.5–2.5μ thick, rather finely verrucose.

II. Uredinia chiefly epiphyllous, somewhat gregarious, oval or oblong, 0.5–1 mm. long, cinnamon-brown, pulverulent; urediniospores broadly ellipsoid or obovoid, 19–21 by 24–31μ, the wall cinnamon-brown, about 2μ thick, finely and closely echinulate, the pores 6–8, scattered.

III. Telia chiefly epiphyllous, more or less gregarious, oval, oblong, or roundish, 0.5–1 mm. long, pulvinate, chocolate-brown or cinereous by germination at maturity, early naked; teliospores ellipsoid or clavate-oblong, 16–24 by 34–45μ, the wall cinnamon-brown, 1–1.5μ thick, thicker at apex, 5–10μ, smooth; pedicel nearly or quite colorless, rather slender, once to twice length of spore.

O and I. Pycnia and aecia on various species of *Arabis* throughout the Rocky mountain region, type collection from Colorado, on *Arabis retrofracta*, made by T. S. Brandegee.

II and III. Uredinia and telia on various species of *Trisetum*, the present known geographical range not so great as for the aecial stage.

3. GYMNOSPORANGIUM NELSONI Arth. (*G. durum* Kern), on *Juniperus utahensis* (Engelm.) Lemmon, sent by Mr. E. Bethel from Delta, Colo., was sown April 5 on *Amelanchier vulgaris*,

A. erecta, Crataegus cerronis, Philadelphus coronarius, and on the last species once more April 12. The only infection was on *Amelanchier vulgaris,* showing pycnia April 24, but failing to mature aecia. Other sowings made in May were without results. The connection with aecia on *Amelanchier* had been predicted by Mr. Bethel from his field observations in Colorado from 1907 to the present season, and also by Mr. A. O. Garrett in Utah, 1910. The same kind of observation is recorded by Tracy & Earle for southern Colorado in 1898.[23] The galls used for these sowings were on small twigs, globoid, and from 1 to 2 cm. in diameter. This form, generally distributed under the name of *G. durum* Kern, has recently been united by Dr. Kern[24] with *G. Nelsoni* Arth. On the type specimens of the latter the galls are small, only 1–8 mm. in diameter, and hence not at first readily identified with the large woody galls, which have been called *G. durum.*

All cultures heretofore reported in this series under the name *G. Nelsoni* belong not to this species but to *G. juvenescens* Kern, as stated in the report for 1910.[25] The latter is a species producing witches' brooms, but not woody galls.

4. GYMNOSPORANGIUM KERNIANUM Bethel, on *Juniperus utahensis* (Engelm.) Lemmon, sent by Mr. Bethel from Paonia, Colo., was sown April 7 on *Amelanchier vulgaris,* and *Crataegus cerronis,* with infection only on the *Amelanchier,* showing pycnia April 17, but not maturing aecia. Another sowing on *Amelanchier vulgaris* April 17 was without result, and the same was true of another collection from Paonia, Colo., sown on the same day. The failure to secure aecia makes it impossible to identify the aecia of this species among the many forms occurring on *Amelanchier,* although it is doubtless already in the hands of collectors. So far as the evidence goes it bears out Mr. Bethel's surmise[26] regarding the aecial hosts. This culture is referred to by Kern[27] in his monograph on the genus *Gymnosporangium.*

5. GYMNOSPORANGIUM EFFUSUM Kern, on *Juniperus virginiana*

[23] Greene, Plantae Bakerianae 1: 19. 1901.

[24] Bull. N. Y. Bot. Gard. 7: 448, 470. 1911.

[25] Mycol. 4: 26. 1912.

[26] See Mycol. 3: 158. 1911.

[27] See Bull. N. Y. Bot. Garden 7: 449. 1911.

L., collected at Newfield, N. J., by Messrs. F. D. Kern and B. O. Dodge, was sown May 4 on *Aronia arbutifolia, Amelanchier canadensis, Pyrus communis, Malus coronaria,* and *M. Malus,* with infection on the first only, showing pycnia in abundance June 15, but failing to develop aecia.

Although this infection did not proceed to a sufficient development to show the identity of the aecia, yet there are some reasons, chiefly relating to host and geographical distribution for thinking that we are dealing with *Roestelia transformans* Ellis, which was described by Mr. Ellis from material collected at Newfield, N. J., on *Aronia arbutifolia.*

6. GYMNOSPORANGIUM GRACILENS (Peck) Kern & Bethel (*G. speciosum* Peck), on *Juniperus monosperma* (Engelm.) Sarg., sent by Mr. Bethel from Trinidad, Colo., was sown April 26 on *Crataegus tomentosa, Sorbus aucuparia,* and *Philadelphus coronarius,* with heavy infection on the last, showing pycnia May 6, and aecia May 29. Before the infection had become certain another sowing was made May 1 on *Amelanchier vulgaris,* and the day following again on another plant of the same host, and also on the fruit of *A. erecta,* as well as the leaves of *Philadelphus coronarius.* Again infection was secured only on the *Philadelphus,* the pycnia showing in the greatest abundance May 13, and aecia June 8.

This connection was suggested by Mr. Bethel, who has given a history of his observations in a recent number of MYCOLOGIA.[28] The result of this set of cultures was communicated to Dr. F. D. Kern, then residing in New York, which enabled him to complete the description and synonymy of the species and to list the aecial hosts in his monograph of the genus *Gymnosporangium.*[29] The connection is especially notable, as it carries the aecial hosts of *Gymnosporangium* outside the families of Malaceae and Rosaceae, into the Hydrangiaceae. As the studies of this genus progress more and more evidence is secured to show that it possesses outlying species approaching in form and habit some of those in other genera.

[28] Bethel, Notes on some species of *Gymnosporangium* in Colorado, Mycol. **3**: 156–160. 1911.

[29] See Bull. N. Y. Bot. Garden **7**: 458. 1911.

The ease with which infection of the garden *Philadelphus,* originally a native of the Caucasus, was secured proved a surprise. Every effort was made to obtain native species of the genus, but without success until too late for culture work.

SUMMARY

The following is a complete list of the successful cultures made during the year 1911. It is divided into two series, species that have previously been grown in cultures and reported by the writer or other investigators, and species whose culture is now reported for the first time.

A. SPECIES PREVIOUSLY REPORTED

1. *Puccinia Peckii* (DeT.) Kellerm.—Teliospores from *Carex lanuginosa* Michx., sown on *Onagra biennis* (L.) Scop.

2. *Puccinia angustata* Peck.—Teliospores from *Scirpus cyperinus* (L.) Kunth, sown on *Lycopus americanus* Muhl.

3. *Puccinia Phragmitis* (Schum.) Körn.—Teliospores from *Phragmites communis* Trin., sown on *Rumex crispus* L.

4. *Puccinia cinerea* Arth.—Teliospores from *Puccinellia airoides* (Nutt.) Wats. & Coult., sown on *Oxygraphis Cymbalaria* (Pursh) Prantl.

5. *Puccinia subnitens* Diet.—Teliospores from *Distichlis spicata* (L.) Greene, sown on *Cleome spinosa* L., *Atriplex hastata* L., and *Chenopodium album* L.

6. *Uromyces Peckianus* Farl.—Teliospores from *Distichlis spicata* (L.) Greene, sown on *Atriplex hastata* L.

7. *Uromyces Medicaginis* Pass.—Urediniospores from *Medicago sativa* L., sown on same species of host.

8. *Gymnosporangium Nidus-avis* Thax.—Teliospores from *Juniperus virginiana* L., sown on fruits of *Amelanchier erecta* Blanch. and leaves of *Malus coronaria* (L.) Mill.

9. *Gymnosporangium clavariaeforme* (Jacq.) DC.—Teliospores from *Juniperus sibirica* Burgsd., sown on fruits of *Amelanchier erecta* Blanch.

10. *Gymnosporangium inconspicuum* Kern.—Teliospores from *Juniperus utahensis* (Engelm.) Lemmon, sown on leaves of *Amelanchier vulgaris* Moench.

11. *Gymnosporangium Libocedri* (P. Henn.) Kern.—Teliospores from *Libocedrus decurrens* Torr., sown on *Amelanchier vulgaris* Moench, *Crataegus tomentosa* L., and *C. cerronis* A. Nels.

12. *Gymnosporangium juniperinum* (L.) Mart. (*G. tremelloides* R. Hartig).—Teliospores from *Juniperus sibirica* Burgsd., sown on *Sorbus americana* Marsh.

13. *Coleosporium Vernoniae* B. & C.—Aeciospores from *Pinus taeda* L., sown on *Vernonia gigantea* (Walt.) Britton.

14. *Melampsora albertensis* Arth.—Teliospores from *Populus tremuloides* Michx., sown on *Pseudotsuga mucronata* (Raf.) Sudw.

15. *Melampsorella elatina* (A. & S.) Arth.—Aeciospores from *Abies lasiocarpa* Nutt., sown on *Cerastium oreophilum* Greene.

B. SPECIES REPORTED NOW FOR THE FIRST TIME

1. *Puccinia Lygodesmiae* Ellis & Ev.—Teliospores from *Lygodesmia juncea* (Pursh) D. Don, sown on the same species of host.

2. *Puccinia monoica* (Peck) Arth.—Aeciospores from *Arabis* sp., sown on *Trisetum subspicatum* (L.) Beauv., and *T. majus* (Vasey) Rydb.

3. *Gymnosporangium Nelsoni* Arth. (*G. durum* Kern).—Teliospores from *Juniperus utahensis* (Engelm.) Lemmon, sown on *Amelanchier vulgaris* Moench.

4. *Gymnosporangium Kernianum* Bethel.—Teliospores from *Juniperus utahensis* (Engelm.) Lemmon, sown on *Amelanchier vulgaris* Moench.

5. *Gymnosporangium effusum* Kern.—Teliospores from *Juniperus virginiana* L., sown on *Aronia arbutifolia* (L.) Ell.

6. *Gymnosporangium gracilens* (Peck) Kern & Bethel.—Teliospores from *Juniperus monosperma* (Engelm.) Sarg., sown on *Philadelphus coronarius* L.

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A BLACK KNOT DISEASE OF DIANTHERA AMERICANA L.

I. M. Lewis

(With Plates 58–61, Containing 10 Figures)

Introduction

During the past two years the water willow, *Dianthera americana,* growing along a small creek near the campus of the University of Texas has been affected with a disease which does not appear to have been heretofore reported. Affected plants were first observed during the summer of 1910, but owing to the pressure of other duties at that time the investigation was only superficial and failed to reveal the true nature of the trouble. At the beginning of the present season however, it was made a subject of special investigation which has brought out clearly the nature of the disease and all of the salient features in the life history of the causal organism. A few points which as yet are not fully determined will be more carefully followed this coming season.

Symptoms of the Disease

The disease affects the aerial portions of the plant and produces numerous hypertrophied areas of the internodes. These areas are not localized on any particular portion of the stem but occur at irregular intervals beginning near the base and extending to the tip. The internode which bears the inflorescence, and midrib of the leaf are frequently affected. The swollen areas vary in length from one to three centimeters and usually completely encircle the stem. The hypertrophy is not uniform but occurs as distinct ridges opposite the peripheral steles, which in this species of *Dianthera* are six in number (Plate LIX, fig. 1).

As the disease develops the outer tissue of the stem is ruptured by a longitudinal fissure and exposes the developing fungus which presents a smooth grayish surface over a dark background

of compact tissue. In typical cases there are six such ruptures, one for each of the peripheral steles. In older stages the fungus areas become somewhat confluent, but they always remain more or less separate. The surface becomes distinctly roughened and papillate with age. The grayish color disappears and the entire area becomes jet black (Plate LVIII, figs. 1 and 2).

ETIOLOGY AND EFFECT ON THE HOST

In order to facilitate the study of the relationship of fungus and host, sections were prepared from normal portions of the stem and from affected areas in different stages of development. The material was fixed in chrom-acetic acid fixing solution and imbedded in celloidin. Both longitudinal and transverse sections were prepared and then stained with aniline safranin and Delafield's haematoxylin.

A section through one of the affected areas reveals the fact that the fungus bears a close relation to the vascular tissue of the host, and that certain definite structural modifications are caused by it.

The stem is polystelic, there being seven steles, six of which are disposed in a circle in the peripheral portion while one occupies a position near the center of the stem. The ground tissue is made up of thin-walled parenchymatous cells with large intercellular spaces typical of aquatic or semiaquatic plants. The steles are orbicular in cross section and each is surrounded by a thin-walled, completely closed endodermis. Inside the endodermis there is a layer of thin-walled stereomatic tissue. The mestome bundles are collateral and arranged in an arch toward the periphery of the stem, while the inner face of the stele is occupied by a pith and a few scattered strands of pure leptome. The cambium lies inside the leptome.

Sections taken from portions of the stem somewhat removed from one of the affected areas show the same structure as a normal unaffected stem except that the vessels of the xylem contain numerous fungal filaments (Plate LXI, fig. 3; Pl. LX, fig. 1). In some cases the vessels are completely filled with the filaments of the fungus.

All portions of the affected plants reveal the presence of these

filaments in the vascular tissue but they never invade the ground tissue except in the swollen areas noted above. Sections have been taken from the aerial portions, the rhizome, and the roots. At this season of the year (November) underground portions of the plant are abundantly supplied with the fungal filaments while the aerial parts have died down and almost completely disappeared. It seems highly probable that these filaments persist throughout the winter and begin growth with the aerial portions in the spring. Strength is afforded this hypothesis by the fact that the disease occurs in localized areas while plants somewhat removed are often unaffected. This point however has not been definitely determined.

The fungus causes decided structural changes in the steles and in the ground tissue immediately surrounding them. These changes are affected only in portions of the stem which become hypertrophied as noted above. The steles are generally changed in outline and frequently become branched. The cambium of the inner face is stimulated to produce new xylem cells and frequently a wedge-shaped area results which is greater in extent than the original stele. The cells of this enlarged portion always contain filaments of the fungus (Plate LX, fig. 1).

The loose, lace-like ground tissue surrounding the stele is replaced by a dark, compact parenchyma with no intercellular spaces. This tissue seems to be made up of cells of both fungus and host but in some cases the host tissue is changed beyond the border of the fungus invasion. This parenchyma develops from the side of the stele directed toward the periphery of the stem, while there is little or none of it produced toward the center. The central stele is also usually affected (Plate LIX, fig. 1). Compare cells of the normal ground tissue in parts of Plate LIX with Plate LX, fig. 1.

The fungus, after it reaches the outer part of the stem, forms a layer of rather loose pseudoparenchyma which bursts open the epidermis producing the pulvinate effect already noted. From this tissue the conidiophores arise. The conidiophore layer is very compact in structure and its outer surface is quite smooth and even. The conidiophores produce numerous crops of spores. In cross section this layer is marked by several

concentric lines (Plate LIX, fig. 2). These lines serve to indicate the number of crops of spores produced as they are formed by the broken stubs or remnants of branches from which the spores have fallen. Figure 2, Plate LIX, shows an area which has borne six or seven crops of spores. This figure shows also the shape and outline of the conidiophore layer.

The conidiophores are somewhat branched, septate, packed very closely together and bear spores at the tip and from very short lateral outgrowths near the tip. They continue growth in length by a lateral branch after the spores have fallen and the broken stubs appear in cross section as distinct lines. The conidiospores are unicellular, oval, hyaline and measure 10 to 15 by 3μ (Plate LXI, fig. 2).

With age this layer begins to slough away, giving the outer surface a very rough ragged appearance. While the conidiophore layer is breaking down a differentiation takes place in the deeper stromatic mass upon which it rests. In transverse sections small cavities appear in the stroma. These are the beginnings of the perithecia and by the time the outer layer of conidiophores have disappeared they are almost fully developed. The perithecia are numerous and closely packed together in the stroma. They are somewhat elongated 475 to 550 by 300 to 350μ and produce rather long necks which open by a definite ostiole. The broken remains of the conidiophore layer together with the necks of the perithecia cause the ragged papillate character of the surface as noted above.

The asci are small, 50 to 65 by 10 to 15μ, thin-walled, and spring from the bottom and sides of the perithecium. The spores are eight in number, biseriate, unicellular, hyaline, allantoid, and measure 6 to 9 by 2μ. There are no paraphyses (Plate LXI, fig. 4). The perithecia do not develop definite walls but each represents rather a loculus in the stroma (Plate LX, fig. 2).

The cultural characters of the fungus are not at present known, as all attempts to grow it in cultures have failed. Attempts were made to isolate from both the conidiospores and the ascospores as well as the tissue from the stroma but without success.

Technical Description

There does not appear to be any described genus to which this fungus can be unreservedly referred. The structure of the stroma and of the perithecium places it among the Dothidiaceae. In many respects it resembles *Plowrightia,* and were it not for the fact that the spores are unicellular there would be little objection to assigning it to that genus. However, the spores described above are of undoubted maturity and such a classification is therefore untenable.

It appears to more nearly agree with *Bagniesiella* than any other described genus and probably does not differ from it sufficiently to warrant the founding of a new genus. The shape of the spores is perhaps the most important feature which differs. In *B. australis* the spores are elliptical with obtuse ends and subinequilateral and are therefore not markedly different from the spores herein described.

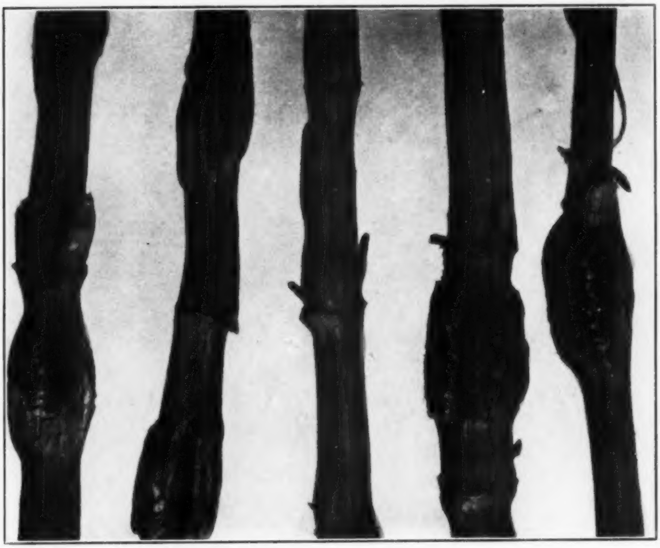
Bagniesiella Diantherae sp. nov.

Stroma erumpent, pulvinate, linear, 10 to 30 mm. in length by 2 to 4 mm. in diameter, black, smooth at first, becoming roughened and tuberculate with age. Conidial stage appearing before the ascigerous and borne on the same stroma. Conidiophores branched, packed closely together, conidiospores hyaline, oval, unicellular, $10–15 \times 3\mu$. Perithecia numerous, subglobose to elongate, immersed in the stroma, $475–550 \times 300–350\mu$. Necks elongate, ostiolate. Asci clavate, $50–65\mu \times 10–15\mu$, without paraphyses, 8-spored. Ascospores biseriate, hyaline, continuous allantoid, $6–9 \times 2\mu$.

On living stems of *Dianthera americana* at Austin, Texas.

In conclusion, the writer wishes to acknowledge his indebtedness to Mrs. Flora W. Patterson for her opinion as to the relationship of the fungus.

UNIVERSITY OF TEXAS,
AUSTIN, TEXAS.



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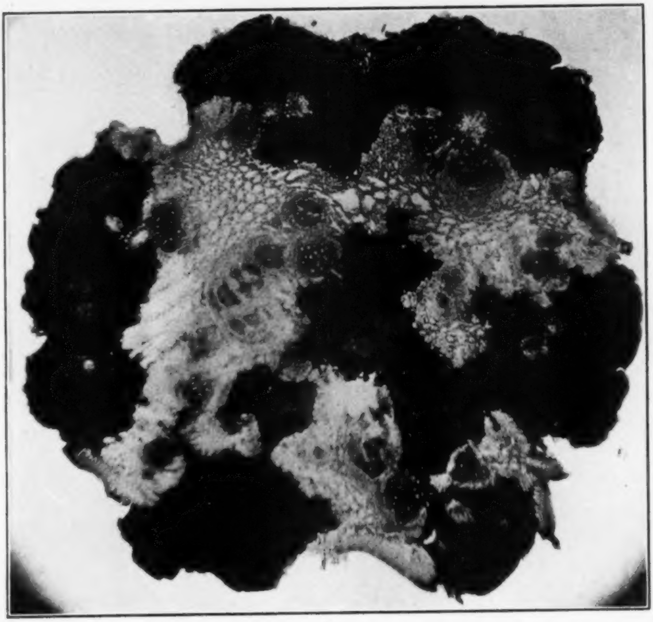

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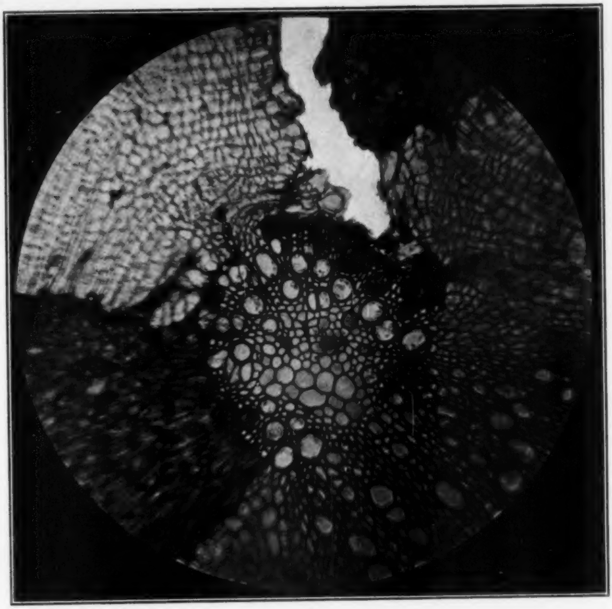

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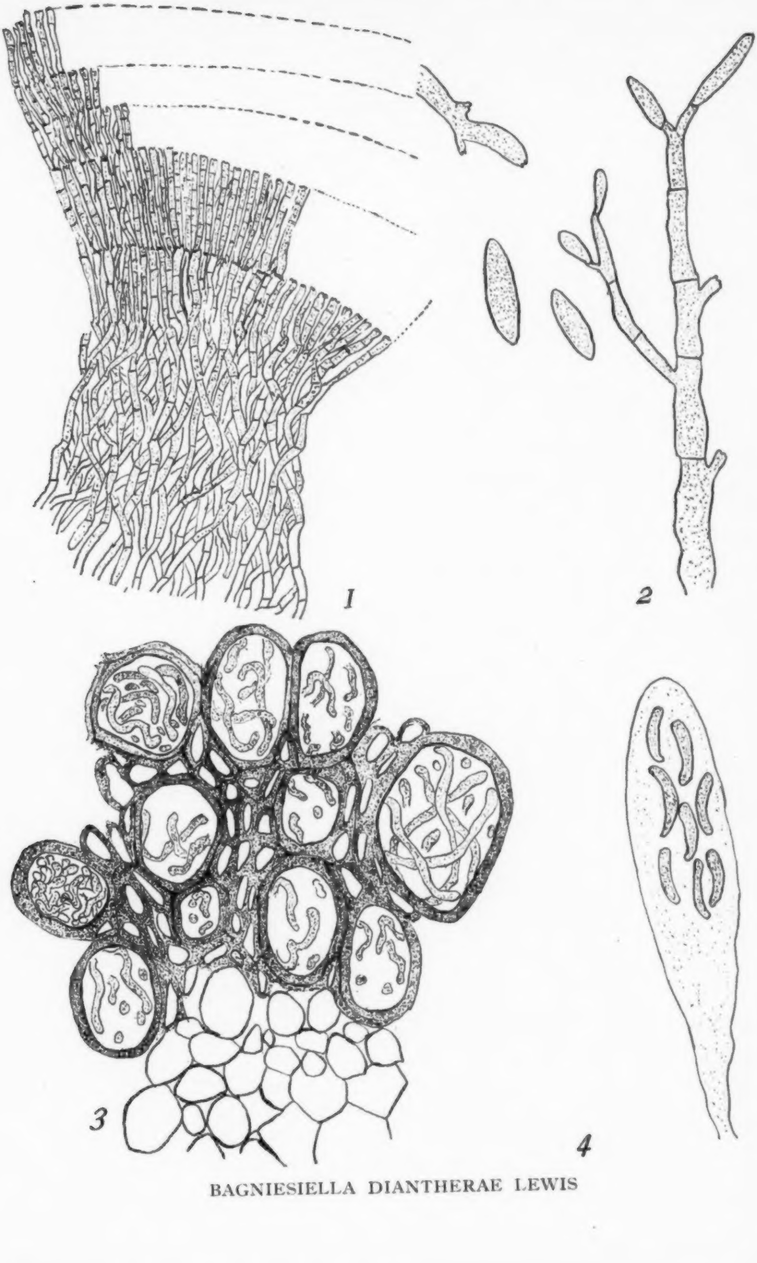


BAGNIESIELLA DIANTHERAE LEWIS

EXPLANATION OF PLATES LVIII–LXI

Plate LVIII, figure 1. Portion of aerial stem of the plant showing hypertrophy opposite the steles and the longitudinal rupture of the host tissue. Both young and older stages are here shown.

Plate LVIII, figure 2. Older stages than shown in figure 1. The fungus areas have become somewhat roughened and tuberculate on the surface.

Plate LIX, figure 1. Transverse section through an affected area. The six peripheral steles and the central one show the effects of the fungus. The ground tissue is normal in portions of the section and shows the changed structure in others. The conidiophore layer may be distinguished around the periphery of the stromata. The clear spaces in the stromata are young perithecia.

Plate LIX, figure 2. A portion of the conidiophore layer more highly magnified. The conidiophores show the concentric zonation which indicates the number of crops of spores they have produced. The dark-colored parenchyma formed by the fungus and host is also shown.

Plate LX, figure 1. One of the peripheral steles showing the formation of additional xylem, the fungal filaments in the vessels, and the changed parenchyma surrounding the steles.

Plate LX, figure 2. Portion of the stroma showing the perithecia and broken ragged nature of the surface of the stroma. The perithecia are immersed locules in the stroma.

Plate LXI, figure 1. Portion of the conidiophore layer showing the uniform zonation. × 300.

Figure 2. Conidiophore and conidiospores. × 800.

Figure 3. Portion of one of the steles showing the location of the fungal tissue within the vessels. × 380.

Figure 4. An ascus with the mature spores. × 1,200.

THE AGARICACEAE OF TROPICAL NORTH AMERICA—V

William A. Murrill

The tropical species with ochraceous or ferruginous spores are treated in this article and the next following in the series. A majority of these species occur on decaying wood. The generic distinctions are not always clearly defined, the group being considered difficult for a beginner.

Lamellae readily separable from the context; pileus dimidiate or resupinate.	1. Tapinia.
Lamellae not readily separable from the contex.	
Volva and annulus absent; veil present at times in young stages, but evanescent.	
Pileus centrally stipitate.	
Stipe cartilaginous.	
Lamellae dissolving at maturity.	2. Mycena.
Lamellae not dissolving at maturity.	
Lamellae free.	3. Pluteolus.
Lamellae adnate or adnexed.	
Margin of pileus straight, from the first.	4. Conocybe.
Margin of pileus at first inflexed.	5. Naucoria.
Stipe fleshy.	
Universal veil arachnoid, distinct from the cuticle; lamellae adnate.	6. Cortinarius.
Universal veil not arachnoid.	
Lamellae sinuate or adnexed.	
Pileus fibrillose or silky.	7. Inocybe.
Pileus smooth and viscid.	8. Hebeloma.
Lamellae adnate or decurrent.	9. Ryssospora.
Pileus dimidiate or resupinate.	10. Phialocybe.
Volva absent, annulus present.	
Pileus hygrophanous.	11. Pholiotina.
Pileus dry.	
Stipe glabrous or fibrillose.	12. Pholiota.
Stipe squarrose-scaly.	13. Hypodendrum.

1. Tapinia (Fries) Karst. Hattsv. 452. 1879

This genus includes the dimidiate or resupinate species of the old genus *Paxillus,* in which the lamellae are usually readily separable from the pileus and anastomose with each other.

Tapinia lignea (Berk. & Curt.)

Paxillus ligneus Berk. & Curt. Jour. Linn. Soc. **9**: 423. 1867.

Collected at Orizaba, Mexico, by Botteri, and said by the authors to be allied to *Paxillus panuoides.* The types at Kew much resemble this latter species, and further investigation may show that they do not merit specific distinction.

2. MYCENA (Pers.) Roussel, Fl. Calvados ed. 2. 64. 1806

Bolbitius Fries, Epicr. Myc. 253. 1838.

This genus is characterized among the ocher-spored genera by its deliquescent lamellae. There are few species in it, and these are not generally well known.

1. **Mycena fragilis** (Fries)

Bolbitius fragilis Fries, Epicr. Myc. 254. 1838.

Reported from the Antilles by Fries, and from two collections by Duss in Guadeloupe.

2. **Mycena villipes** (Fries)

Bolbitius villipes Fries, Nova Acta Soc. Sci. Upsal. III. **1**: 28. 1851.

Collected and well figured in color by Oersted at Naranjo, Costa Rica. No specimens of it were found in Europe.

3. **Mycena jalapensis** sp. nov.

Pileus conic to expanded, thin, umbonate, gregarious, 2–4 cm. broad; surface viscid, striate, flavo-melleous, fulvous on the umbo; lamellae free, narrow, close, becoming ferruginous, at length deliquescent; spores ellipsoid or ovoid, smooth, flavo-luteous under a microscope, $12–14 \times 6–8\mu$; stipe cylindric, equal, hollow, glabrous, white or sulfureous, 6–8 cm. long, 2 mm. thick.

Type collected among chips in woods near Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 102 (type), 128.*

4. **Mycena mexicana** sp. nov.

Pileus subcespitose, conic to expanded, umbonate, about 2 cm. broad; surface striate, avellaneous, fuliginous on the umbo, subglabrous, dry; lamellae adnexed, rather broad, becoming ferru-

ginous and at length slightly deliquescent; spores ovoid, smooth, ochroleucous under a microscope, usually uninucleate, 8–9 × 4.5–5μ; stipe slender, white, glabrous, cylindric, equal, hollow, 3–4 cm. long, 1 mm. thick.

Type collected on decayed wood in coffee plantations at Xuchiles, near Cordoba, Mexico, January 17, 1910, *W. A. & Edna L. Murrill 1127.*

3. PLUTEOLUS (Fries) Gillet, Champ. Fr. **1**: 549. 1876

This genus has free lamellae and neither volva nor veil. Few species are known.

Pluteolus tropicalis sp. nov.

Pileus thin, delicate, expanded, 3–5 cm. broad; surface pale-isabelline or ochraceous, glabrous, striate to the disk; context very thin, brownish, mild, with a strong odor of jessamine; lamellae free, crowded, narrow, ochraceous or isabelline to dull-cinnamon; spores ellipsoid, smooth, slightly truncate at one end, with one or more nuclei, ferruginous, 12–14 × 7μ; stipe cylindric, slightly tapering upward, pruinose-floccose, whitish, with flesh tints below, hollow, fragile, 7–10 cm. long, 3–4 mm. thick.

Type collected on rotting grass in a plowed field at Herradura, Cuba, August 28, 1906, *F. S. Earle 536.* Also collected in a banana field at Santiago de las Vegas, Cuba, June 18, 1904, *F. S. Earle 102;* in grassy ground at Rincon, Cuba, September 8, 1904, *F. S. Earle 165;* and several times on the ground and once in a bamboo stump at St. George's, Grenada, July and August, 1905, *W. E. Broadway.*

4. CONOCYBE Fayod, Ann. Sci. Nat. VII. **9**: 357. 1889

Galera (Fries) Quél. Champ. Jura Vosg. 103. 1872. Not *Galera* Blume. 1825.

This genus differs from *Naucoria* in having the margin straight and appressed to the stipe, instead of incurved, in young stages.

1. CONOCYBE TENER (Schaeff.) Fayod, Ann. Sci. Nat. VII. **9**: 357. 1889

Galera tener (Schaeff.) Quél. Champ. Jura Vosg. 104. 1872.
Galera simulans Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 236. 1906. (Type from Cuba.)

Galera grisea Earle, Inform. An. Estaç. Centr. Agron. Cuba **1**: 237. 1906. (Type from Cuba.)

Galera cubensis Earle, Inform. An Estaç. Centr. Agron. Cuba **1**: 237. 1906.

This dainty little fungus occurs abundantly on lawns and in manured pastures in temperate regions, and has recently been found to be common about Santiago de las Vegas, Cuba.

Jalapa, Mexico, *W. A. & Edna L. Murrill 139;* Hope Gardens, Jamaica, *Earle 338;* Port Antonio, Jamaica, *W. A. & Edna L. Murrill 223, 245;* Cuba, *Earle 42, 43, 53, 54, 99, 100, 101, 129, 164, 359, 360, 372, 374, Underwood & Earle 1122;* British Honduras, *M. E. Peck;* Grenada, *Broadway.*

2. **Conocybe Hypnorum** (Batsch)

Galera Hypnorum (Batsch) Quél. Champ. Jura Vosg. 105. 1872.

This tiny species is of wide distribution in temperate regions, occurring among mosses or grasses in shaded localities. The cap is conic, striate, variable in color, usually some shade of yellowish-brown. The spores of the Mexican plants are smaller than in typical temperate specimens, and the pileus is pale-isabelline.

Jalapa, Mexico, among mosses in a pasture at the edge of a forest, *W. A. & Edna L. Murrill 109.*

3. **Conocybe echinospora** sp. nov.

Pileus conic to campanulate or convex, umbonate, solitary, 5 mm. broad and high; surface glabrous, dry, striate, fulvous-isabelline, isabelline on the umbo, margin straight, appressed, entire; lamellae broad, distant, fulvous-isabelline; spores broadly ovoid, pointed at one end, minutely echinulate, ferruginous, $7–8 \times 4–5\mu$; stipe glabrous, smooth, slightly tapering upward, very pale latericeous, 1–1.5 cm. long, less than 1 mm. thick.

Type collected on a clay bank at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–9, *W. A. & Edna L. Murrill 474.*

5. NAUCORIA (Fries) Quél. Champ. Jura Vosg. 99. 1872

In this genus the lamellae are adnexed or adnate, the stipe cartilaginous, and the margin inrolled when young, usually lack-

ing a veil. The spores vary in color from ochraceous to fulvous. Temperate species are numerous and difficult; several have also been described from the tropics.

1. NAUCORIA EUTHUGRAMMUS (Berk. & Curt.) Sacc. Syll. Fung. **5**: 835. 1887

Agaricus (Naucoria) euthugrammus Berk. & Curt. Jour. Linn. Soc. **10**: 290. 1868.

Described from Wright's collections on rotten wood in Cuba. Very thin, less than 1 cm. broad, pallid-umbrinous, convex, striate, with filiform, hyaline stipe and minute spores.

2. NAUCORIA OINODES (Berk. & Curt.) Sacc. Syll. Fung. **5**: 842. 1887

Agaricus (Naucoria) oinodes Berk. & Curt. Jour. Linn. Soc. **10**: 291. 1868.

Described from specimens collected by Wright on rotten wood in Cuba. Less than 1 cm. broad, umbonate-hemispheric, vinous, glabrous, striate, with short, fuscous stipe.

3. NAUCORIA PECTINATA (Berk. & Curt.) Sacc. Syll. Fung. **5**: 856. 1887

Agaricus (Naucoria) pectinatus Berk. & Curt. Jour. Linn. Soc. **10**: 291. 1868.

Cespitose on logs, glabrous, striate, 2.5 cm. broad. Types at Kew and Paris are well preserved.

Cuba, *Wright 81;* Mooretown, Jamaica, *Earle 561.*

4. NAUCORIA SEMIORBICULARIS (Bull.) Quél. Champ. Jura Vosg. 100. 1872

Agaricus semiorbicularis Bull. Champ. Fr. *pl. 422. f. 1.* 1788.
Agaricus (Psilocybe) pediades Fries, Syst. Myc. **1**: 290. 1821.
Naucoria pediades Quél. Champ. Jura Vosg. 100. 1872.

This species appears to be common throughout both temperate and tropical regions, appearing abundantly along roads and paths and in grassy places during periods of wet weather. Like most cosmopolitan species, it shows considerable variation, even in spore characters.

Costa Rica, *Oersted;* Santa Cruz, *Oersted;* Guadeloupe, *Duss;* Cuba, *Wright, Earle 540;* Mexico, *Maury, W. A. & Edna L. Murrill 93;* Castleton Gardens, Jamaica, *Earle 233.*

5. **Naucoria corticola** sp. nov.

Pileus thin, convex to subexpanded, gregarious, 1–1.5 cm. broad; surface avellaneous-isabelline, innate-fibrillose with slight tufts, resembling that of *Panus stypticus,* margin undulate, incurved when young; lamellae adnate, dull-whitish to bay-fulvous, broad, heterophyllous, rather distant; spores ellipsoid, smooth, ferruginous, $8–9 \times 4–5\mu$; stipe cylindric, equal, yellow, glabrous at the apex, whitish-pubescent below, 1 cm. long, 1 mm. thick.

Type collected on the bark of a dead stump at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 533.*

6. **Naucoria cyathicola** sp. nov.

Pileus hemispheric-umbonate to convex, 7–12 mm. broad; surface isabelline, pale-fulvous on the umbo, innate-fibrillose, margin entire, not striate; lamellae distant, squarely adnate, whitish to pale-ochraceous; spores oblong-ellipsoid, smooth, very pale yellowish under the microscope, $6 \times 3.5\mu$; stipe subequal, cylindric, fibrillose, isabelline, cartilaginous, 2 cm. long, 1.5 mm. thick; veil not evident, except in fibrils on stipe and pileus.

Type collected on dead trunks of tree-ferns at Morce's Gap, Jamaica, 5,000 ft. elevation, January 2, 1909, *W. A. & Edna L. Murrill 699.*

7. **Naucoria Earlei** sp. nov.

Pileus thin, convex to expanded or depressed, 2–3 cm. broad; surface glabrous, pallid or alutaceous, margin even or slightly striate; lamellae slightly adnexed, subdistant, rather narrow but ventricose, pallid to fuscous; spores ellipsoid, smooth, fuscous, $10–12 \times 6–8\mu$; stipe cylindric, solid, firm, glabrous, pallid to brownish, darker than the pileus, 3–4 cm. long, 2 mm. thick.

Type collected on damp, bare ground, Castleton Gardens, Jamaica, October 28, 1902, *F. S. Earle 230.*

8. **Naucoria jalapensis** sp. nov.

Pileus thin, conic to convex, umbonate, 2.5 cm. broad; surface pearly-white, slightly yellowish on the umbo, glabrous, dry, stri-

ate, margin at first inflexed; lamellae sinuate-adnexed, broad, rather distant, plane, white to ferruginous, with a purplish tint; spores ovoid or ellipsoid, drawn to a point at one side of the base, smooth, pale-yellow under the microscope, $7 \times 4\mu$; stipe equal, cylindric, curved, milky-white, glabrous, 5 cm. long, 2 mm. thick; veil fibrillose, clinging to the young margin, soon evanescent.

Type collected on dead wood in a moist virgin forest at Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 161.*

9. **Naucoria hepaticicola** sp. nov.

Pileus hemispheric to convex, gregarious, 1 cm. broad; surface dry, glabrous, smooth, not striate, fulvous; lamellae adnate, plane or slightly arcuate, broad, distant, inserted, melleous to fulvous; spores ovoid, somewhat irregular in outline, pointed at one end, smooth, uninucleate, melleous, $7–9 \times 4–5\mu$; stipe curved, tapering upward, glabrous, smooth, cartilaginous, 1.5 cm. long, 2 mm. thick above; veil very slight, fibrillose, evanescent.

Type collected on and among liverworts on a clay bank near Jalapa, Mexico, 5,000 ft. elevation, December 12–20, 1909, *W. A. & Edna L. Murrill 131.*

10. **Naucoria montana** sp. nov.

Pileus hemispheric-umbonate, gregarious, 1–2 cm. broad; surface glabrous, striate, light-brown, dark-brown on the umbo; lamellae adnate, broad, of medium distance, heterophyllous; spores pip-shaped, pointed at one or both ends, minutely echinulate, ferruginous, $9–11 \times 4–5\mu$; stipe crooked, slender, cylindric, equal, glabrous, brown above, fuliginous below, 3–4 cm. long, 1–2 mm. thick.

Type collected on dead wood at Cinchona, Jamaica, 5,000 ft. elevation, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 621.* Also collected on dead wood at Morce's Gap, Jamaica, December 29, 1908, *W. A. & Edna L. Murrill 675,* and on Sir John Peak, Jamaica, 6,000 ft. elevation, January 5, 1909, *W. A. Murrill 819.*

11. **Naucoria pellucida** sp. nov.

Pileus thin, conic to plane, umbonate, 7 mm. broad; surface bay to latericeous on the umbo, testaceous and striate between the

umbo and the margin, dotted over the surface with translucent, gelatinous, pearly-white droplets or specks; lamellae adnexed, ventricose, distant, pale-testaceous, marked with droplets like those on the surface of the pileus; spores ellipsoid, finely echinulate, fulvous, $8 \times 5\mu$; stipe cylindric, equal, smooth, pallid above, bay below, guttate, 1 cm. long, 0.5 mm. thick.

Type collected on dead wood at New Haven Gap, Jamaica, 5,600 ft. elevation, January 4, 1909, *W. A. & Edna L. Murrill 763*. Whether the dots that cover the surface of this tiny species are the remains of a universal veil as in *Tubaria pellucida* or are droplets exuded from the plant under conditions of a maximum amount of moisture, it is impossible at this time to say.

12. **Naucoria Sacchari** sp. nov.

Pileus thin, subfleshy, convex to expanded, obtuse, 1–1.5 cm. broad; surface moist, subviscid, not striate, slightly floccose-scaly to glabrous, pale-fuscous, shading to nearly white on the margin; lamellae adnate, distant, nearly plane, rather broad, pale-fuscous; spores smooth, ellipsoid, ferruginous, $10\text{–}12 \times 7\text{–}8\mu$; stipe cylindric, hollow, floccose, concolorous, 3–4 cm. long, 1 mm. thick.

Type collected on rotting sugar-cane trash at Hope Gardens, Jamaica, October 31, 1902, *F. S. Earle 322*. The description is drawn from the very complete notes made by Professor Earle from the fresh specimens.

13. **Naucoria spinulifer** sp. nov.

Pileus hemispheric-umbonate with revolute margin, 2 cm. broad; surface innate-fibrillose, smooth, isabelline, testaceous on the umbo, cremeous at the margin; lamellae adnate, arcuate, of medium breadth and distance, dull purplish-isabelline; spores ellipsoid, smooth, ferruginous, $5\text{–}7 \times 3.5\text{–}4\mu$; cystidia hyaline, flask-shaped with short slender stalk and long cylindric neck, $10\text{–}15\mu$ thick, $30\text{–}50\mu$ long, including the stalk; stipe curved, cylindric, equal, subglabrous, stramineous above, fulvous below, 2.5 cm. long, 2.5 mm. thick.

Type collected on dead wood at Morce's Gap, Jamaica, 5,000 ft. elevation, December 30, 1908, *W. A. & Edna L. Murrill 705*.

14. **Naucoria tepeitensis** sp. nov.

Pileus very thin, convex, gregarious, reaching 12 mm. broad; surface smooth, whitish, hygrophanous, faintly striate over the

lamellae, margin entire, inrolled when young; lamellae free to adnate, whitish, dull, several times inserted, broad, distant, the edges white and slightly crenulate; spores subovoid, slightly flattened on one side, smooth, uninucleate, very pale melleous under the microscope, $6 \times 4\mu$; stipe crooked, arising from a mat of white mycelium, slightly enlarged above, smooth, glabrous, whitish, hygrophanous, 1 cm. long, about 1 mm. thick.

Type collected on a rotten log in a moist virgin forest in the Tepeite Valley, near Cuernavaca, Mexico, 7,000 ft. elevation, December 28, 1909, *W. A. & Edna L. Murrill 485*.

15. **Naucoria Underwoodii** sp. nov.

Pileus thin, rather fleshy, convex to expanded, scattered, 2 cm. broad; surface glabrous, hygrophanous, brownish, ochraceous when dry, the disk darker; lamellae adnexed, subcrowded, rather broad, subventricose, dull-fulvous; spores broadly ellipsoid, smooth, $8–9 \times 6–7\mu$; stipe crooked, slightly larger below, concolorous, hollow, subfibrillose, the apex floccose-fibrillose, 3 cm. long, 3 mm. thick.

Type collected on rotten wood on El Yunque, Cuba, 1,800 ft. elevation, March, 1903, *Underwood & Earle 1237*.

16. **Naucoria xuchilensis** sp. nov.

Pileus convex to plane, slightly depressed, solitary, 3.5 cm. broad; surface ochraceous, slightly fulvous at the center, subglabrous, even; lamellae adnate, broad, distant, inserted, fulvous; spores ovoid, smooth, uninucleate, ochroleucous, $7–9 \times 4–5\mu$; stipe cylindric, equal, glabrous, cremeous, 2 cm. long, 3 mm. thick.

Type collected in rich, low ground under coffee trees at Xuchiles, near Cordoba, Mexico, 1,500 ft. elevation, January 17, 1910, *W. A. & Edna L. Murrill 1124*.

DOUBTFUL SPECIES

Agaricus (*Naucoria*) ***papularis*** Fries, Nova Acta Soc. Sci. Upsal. III. **1**: 225. 1851. Collected by Krebs in the island of St. Thomas. Types not found.

Naucoria sideroides (Bull.) Quél. Champ. Jura Vosg. 99. 1872. Reported by Berkeley from Wright's Cuban collections, but evidently a wrong determination.

Agaricus (*Naucoria*) *arenicola* Berk. (Fungi Zeyh. no. 6). Reported by Fries from Oersted's collections in Costa Rica, but very probably different from the South African species. Oersted's figures are unsatisfactory and no specimens are to be found.

Agaricus (*Naucoria*) *cerodes* Fries, Epicr. Myc. 195. 1838. Reported from Santo Domingo, but probably another case of incorrect determination.

Agaricus (*Naucoria*) *coprinoceps* Berk. & Curt. Jour. Linn. Soc. **10**: 290. 1868. Collected by Wright in Cuba. Spores too dark for *Naucoria;* probably a *Psathyra,* one of the brown-spored genera.

6. CORTINARIUS (Pers.) Roussel, Fl. Calvados ed. 2. 61. 1806

This very large and difficult temperate genus has been divided comparatively recently along the subgeneric lines laid down by Fries, but for our present purpose, where only one or two species are concerned, it seems best to retain the old name and to omit synonyms.

Cortinarius mexicanus sp. nov.

Pileus convex, solitary, 4 cm. broad; surface pallid with a lilac tint, ferruginous in places, slightly viscid when moist, margin even; lamellae slightly arcuate, adnexed or rarely free, close, regular, deep-lilac; spores boat-shaped, slightly one-sided at one end, regular, minutely echinulate, ferruginous, $11–12 \times 4–5 \mu$; stipe shining-white with a lilac tint, this tint deepening above, cylindric, abruptly bulbous at the base, 5 cm. long, about 6 mm. thick; veil fibrillose, evanescent, soon ferruginous from the spores.

Type collected on humus in a moist virgin forest at Jalapa, Mexico, December 12–20, 1909, *W. A. & Edna L. Murrill 197.*

DOUBTFUL SPECIES

Cortinarius Sintenisii P. Henn. Engl. Jahrb. **17**: 498. 1893. Collected by P. Sintenis on trunks in Porto Rico, and said by the author to be allied to *C. cinnamomeus.* The type specimens have not been examined.

7. INOCYBE (Fries) Quél. Champ. Jura Vosg. 151. 1872

A very large and difficult temperate genus having sinuate or adnexed lamellae and a silky or fibrillose pileus.

Inocybe jamaicensis sp. nov.

Pileus convex with a prominent umbo, especially when young, gregarious, 2–3 cm. broad, 1.5 cm. thick; surface fulvous, minutely imbricate-fibrillose-scaly, margin fading to isabelline with age; lamellae adnate, dirty-white, distant, heterophyllous; spores irregular, angular or nodulose, nearly hyaline under the microscope, copious, 8–9 × 5μ; cystidia turbinate, pointed at each end, 25 × 17μ; stipe equal or slightly larger above, cylindric, avellaneous to brownish below, nearly white above, 3–4 cm. long, 3–5 mm. thick.

Type collected in a clay road at Cinchona, Jamaica, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 595*.

8. HEBELOMA (Fries) Quél. Champ. Jura Vosg. 334. 1872

This genus has a smooth and usually somewhat viscid cap, sinuate or adnexed lamellae, a fleshy stipe, and a slight, evanescent veil. It is well represented in temperate regions.

1. **Hebeloma Broadwayi** sp. nov.

Pileus fleshy, convex to expanded, 2–4 cm. broad; surface white, glabrous, subviscid, not striate; lamellae adnexed, crowded, rather narrow, white to ochraceous-fulvous, the edge white, crenulate; spores ochraceous-fulvous, ellipsoid, 12–14 × 7–8μ; stipe cylindric, white, glabrous, hollow, 3–4 cm. long, 2–4 mm. thick.

Type collected along roadsides in lowlands at St. George's, Grenada, *W. E. Broadway.*

2. **Hebeloma cinchonense** sp. nov.

Pileus convex to expanded, umbonate, gregarious, 3–6 cm. broad, 1–2 cm. thick; surface pale-isabelline, rarely milky-white with a stramineous tinge, viscid, smooth, margin white, thin, straight, slightly cottony; context white, without characteristic taste; lamellae white, sinuate-adnexed, ventricose, broad; spores pip-shaped, smooth, with a single large, clear nucleus, pale-melleous under the microscope, 8 × 4μ; stipe fleshy with a thin rind,

enlarged below, abruptly bulbous at the base, glabrous, white or pale-yellowish, 3–6 cm. long, 7–10 mm. thick; veil slight, fibrillose, evanescent.

Type collected on the ground in a trail at Cinchona, Jamaica, December 25–January 8, 1908–09, *W. A. & Edna L. Murrill 568.* Also collected in a clay road at Cinchona, Jamaica, *W. A. & Edna L. Murrill 501,* and at New Haven Gap near Cinchona, Jamaica, *W. A. & Edna L. Murrill 772.* This species was apparently abundant about Cinchona at the time of my visit, but it was impossible to obtain many specimens on account of the mongoose, which ate them very greedily.

3. **Hebeloma subincarnatum** sp. nov.

Pileus conic to plane, gregarious, 2–2.5 cm. broad, 7 mm. thick; surface smooth, glabrous, incarnate-isabelline, margin straight; lamellae adnexed, nearly free, cremeous when young, soon becoming luteous, broad, ventricose; spores subellipsoid, one-sided, smooth, with one or two nuclei, very pale yellowish, $8 \times 4\mu$; stipe crooked, cylindric, equal, smooth, ochraceous, fibrillose when young, especially at the top, 3 cm. long, 2.5 cm. thick.

Type collected among moss growing on clay soil in the trail from Monkey Hill to Sir John Peak, 6,000 ft. elevation, January 5, 1909, *W. A. Murrill 795.*

DOUBTFUL SPECIES

Hebeloma longicaudum (Pers.) Quél. Champ. Jura Vosg. **2**: 334. 1874. Certain plants collected by Maury in Mexico have been identified as this species.

NEW YORK BOTANICAL GARDEN.

NOTES ON IOWA SAPROPHYTES—I

GEASTER MINIMUS SCHW. AND ITS RELATIVES

T. H. Macbride

(With Plate 62, Containing 3 Figures)

Geaster minimus Schw. is a beautiful little species found at times in considerable numbers growing amid the grass in places where this by reason of lighter soil is not too dense. It has been reported from various parts of the world but so far, in North America, from the eastern, forested region of the continent only. The type would appear to have been taken in South Carolina, perhaps about 1821, where it was found later also by Ravenel. It occurs, as reported, in South America, in Ceylon, Australia, Borneo, but, curiously, not in Europe.

However, in 1842, Vittadini described from northern Italy a little geaster, *G. marginatus,* which according to Saccardo is related to the Schweinitzian type and "appears to differ in the form of endoperidium only and in the '*rima*' around the peristome." This "*rima*" is, properly speaking, a fissure, slit, or other elongated opening. Morgan (Jour. Cin. Soc., 1899) translates *rima* "chink" and says it appears sometimes in specimens recognized by him as *G. minimus* Schw. A chink in the sense of an opening or a fissure would seem here a morphological impossibility. Such a chink would cut out the peristomic areole.

Schweinitz describes *Geaster minimus* (Syn. Fung. Carol., No. 327): Peridium ovate, at the base plane, white, subpedicellate: the mouth plano-conic, ciliate; the volva (the outer peridium) multifid, fuscescent, white below. Everywhere, on the bare ground in grassy places. Peridium of the size of a large pea, pedicellate. The mouth plano-conic from adhering cilia which are at length revolute and free at the apex. The several lobes (of the outer peridium) elegantly revolute, from the entire arched base; where they touch the ground, fuscescent, white below, occu-

pying the space of ½ inch when expanded. Schweinitz evidently knew naught of chink or "*rima.*"

De Toni in Revue Mycologique, 1887, p. 73, brings us, however, some help. De Toni, speaking of the Italian form, *G. marginatus* of Vittadini, says: "Cette espéce est donc une des plus petites du genre: elle diffère du *G. minimus* S. par la forme du peridium interne, et par la sillon autour du peristome." That is, "this species is one of the least of the genus: it differs from *G. minimus* by the form of the inner peridium and by the furrow around the peristome." Furrow or groove will do. The furrow, however, is owing to the elevation of a sort of marginal crest rather than to any marked depression around the areole.

Some years since, a tiny geaster was brought in, taken under a thicket of *Juniperus virginianus* L. The form closely resembles specimens of *G. minimus* Schw. but differs in several minor particulars. It is also like *G. marginatus* Vitt. but lacks the furrow.

It has seemed worth while to record this western form in order to make comparison of the three. It may be characterized as follows:

Geaster juniperinus sp. nov.

Outer peridium multifid, variable, 5–9-lobed; inner peridium ovate, elongate, pedicellate, white or bluish-white; stoma conic, ciliate, rising from a definite but only slightly depressed areole; columella stout; capillitial threads smooth, pallid by transmitted light, in diameter about 3μ; spores globose, warted, dark-brown, almost black in mass, about 3μ.

On the ground beneath juniper trees, Iowa. The figures on the accompanying plate, by Jessie Parish, show the slight differences separating the kindred forms.

The Schweinitzian species in all cases observed are more nearly spherical, with paler and more coarsely warted spores. Vittadini's, *i. e.*, the European type, is intermediate, has different spores, more elongate inner peridium, and depressed areole. The Iowa form differs in color, in spore-color and markings, approaching *G. minimus* in areole, and *G. marginatus* in other points of structure. The columella in *G. minimus* is almost nil; in *G. juniperinus* well developed, strong, and persistent.

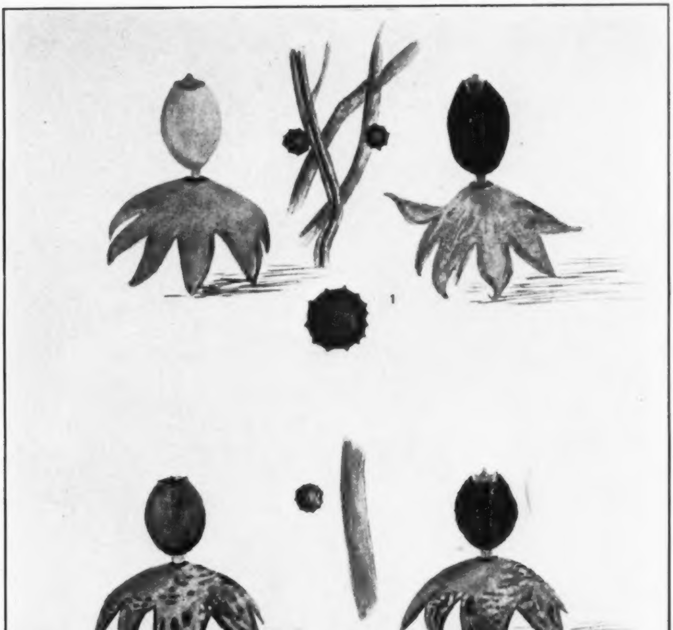
IOWA CITY, IOWA,
Oct. 20, 1911.

EXPLANATION OF PLATE LXII

Fig. 1. *Geaster juniperinus* Macbride. Sporophore, × 1. Sporophore, showing section of inner peridium, × 1. Capillitium, threads and spores, × 1,130. A single spore, × 930.

Fig. 2. *Geaster marginatus* Vittadini. Sporophore, × 1. Sporophore, showing cross section of inner peridium, × 1. Capillitium, thread and spore, × 1,000.

Fig. 3. *Geaster minimus* Schweinitz. Sporophore, × 1. Sporophore, showing cross section of inner peridium, × 1. Capillitium, threads and spore, × 1,000.



1. GEASTER JUNIPERINUS MACBRIDE
2. GEASTER MARGINATUS VITTADINI
3. GEASTER MINIMUS SCHWEINITZ

THRAUSTOTHECA CLAVATA

W. C. Coker and O. W. Hyman

(With Plate 63, Containing 10 Figures)

During the course of our study of the Saprolegniaceae we brought into the laboratory early in January, 1911, a number of collections from promising pools and runs. Several different species developed in a couple of days. One of these taken from an open ditch in the arboretum was at once conspicuous on account of its stout hyphae and irregular branches. This soon developed club-shaped sporangia and by its method of spore liberation was at once recognized as the rare and interesting species *Thraustotheca clavata* (De Bary) Humphrey.

This mold seems not to have been found since its first discovery in 1880. In 1888 De Bary described it as a new species under the name of *Dictyuchus clavatus*.[1] He got his specimens from a collection of algal material taken in 1880 by Stahl from a fresh-water lake at Vendenheim near Strassburg, Germany, and kept it growing in his laboratory for four years. The species was really first published incidentally by Büsgen in 1882,[2] who in his study of the development of the sporangia described it sufficiently under the name of *Dictyuchus clavatus* De Bary sp. nov.

On account of the unparalleled method of spore liberation it was suggested by Solms-Laubach, who, after De Bary's death, arranged and edited his last paper, that this species might be considered as generically distinct from the other species of *Dictyuchus*. This was again remarked on by Fisher in 1892,[3] and the next year, Humphrey in his Saprolegniaceae of the United States was sufficiently impressed with its distinction to give it the generic name of *Thraustotheca*.

A pure culture of our Chapel Hill plant was obtained as fol-

[1] Bot. Zeitung **46**: 649. 1888.

[2] Pringsheim's Jahrb. f. wiss. Botanik, **13**: 253. 1882.

[3] Rabenhorst's Kryptagamen Flora **1**: 365. 1892.

lows: A petri dish of sterilized agar-agar was inoculated with a drop of water containing free spores. After a few hours the spores sprouted. When the young fungus had grown sufficiently to be discernible with the naked eye it was cut out, together with the immediately surrounding medium and transplanted to a dish of fresh agar-agar. When the growth had become quite robust flies were inoculated, and fine cultures soon resulted. The species was kept growing and under observation for the rest of the term.

The main hyphae of *Thraustotheca* are stout, straight, and profusely branching into secondary hyphae near their tips. The secondary hyphae are much curved and twisted, and are often curiously knobbed and gnarled as shown in fig. 1. The main hyphae reach a length of 2 cm. in strong cultures, and vary in diameter from 20μ to 120μ averaging about 37μ. The sporangia are borne terminally, the hypha continuing from a sub-sporangial branch (fig. 2). The sporangia are typically short, broad, and clavate, differing from the sporangia of any other of the Saprolegniaceae. They vary from almost spherical on the one hand to fusiform on the other. The spores encyst within the sporangium immediately after they are formed. They are polyhedral in shape, through pressure, each having a hyaline membrane of its own (fig. 3). After the encysting of the spores, the sporangial wall, which has always been thin, begins to disappear, vanishing first as a rule on one side near the end of the club, and continuing to disintegrate until nothing is left of it except a narrow circular ring at the base. This basal ring may be quite conspicuous (figs. 4 and 5) or almost entirely absent.

This method of dehiscence is entirely unique among the water molds, and reminds us at once of the mold *Mucor* and its relatives. This resemblance was remarked on at the time the plant was described, and Solms-Laubach thought he saw another point of agreement between *Mucor* and our plant in the outward bulging of the basal partition. This, however, seems to us to be scarcely if at all noticeable in *Thraustotheca*. De Bary's figures show it scarcely at all, and neither do ours.

As the disintegration of the wall proceeds the spores fall apart irregularly. They then emerge from their cysts and swarm in

laterally biciliate form. Finally they encyst again and sprout. At the time of the final encystment the spores are of course spherical, measuring about 12.5μ in diameter.

The oögonia are borne singly on short, straight, perpendicular branches from the secondary hyphae, rarely from the primaries. At the time when the eggs are fully ripe the oögonia measure about 59μ in diameter. They are spherical, smooth, and very slightly pitted, the pits appearing only after staining with chlor-zinc-iodide. Each oögonium contains from 1 to 8 eggs (fig. 6). The usual number of eggs is either 4 or 6. Ripe eggs are spherical or slightly angular from pressure, excentric, with a single large peripheral oil globule (fig. 6). They are very constant as to size with a diameter of from 20μ to 22μ. The antheridial branches also arise from the secondary hyphae. They are long, very crooked, and quite stout. The ends of the antheridial branches become closely applied to the surface of the oögonium, and club-shaped antheridia are cut off from their tips (fig. 7). In many cases it was noted that the antheridium gave off a short tube which entered the oögonium and became applied to an egg (fig. 6). The actual fertilization of the egg was never seen but the antheridia were observed to become empty during the ripening of the eggs. In no case was it found that an antheridial tube became attached to an oögonium arising from the same hypha as itself.

The formation of the oögonia and eggs may be easily watched in this species. The protoplasm of the hypha flows out into the oögonial branch, rapidly packing it with densely granular substance. The tip of the branch swells into a rounded sphere which is packed with a very dense protoplasm. This tip is then cut off from the oögonial branch by a cross wall and the oögonium has been formed.

The substance within the oögonium is at first entirely homogeneous. After some time it may be noticed that oil drops are collecting at the periphery of the protoplasmic mass (figs. 7, 8, and 10). The protoplasmic mass then begins to divide, the division beginning at the center and traveling towards the periphery. At first a clear space appears in the center of the mass from which radial spaces gradually extend outward. The eggs when

first separated are roughly pyramidal in shape, their bases resting on the wall of the oögonium . Gradually the eggs become spherical and acquire a thick, hyaline membrane. When they first become spherical they show many oil globules situated on one side of the egg (fig. 10). These globules are at first only about 2μ in diameter, but they gradually fuse until there are only two or three larger ones from 8μ to 15μ in diameter. Finally these globules fuse into a single one, which is about 16μ in diameter, and situated at the periphery of the egg. The eggs are then ripe.

In old cultures an oögonium would often sprout a new one, the old being emptied into the new (fig. 9). This process might be repeated several times and the eggs be formed finally in the terminal oögonium (fig. 8).

Occasionally two oögonia were produced upon one branch, or an antheridial filament was found coming from an oögonial branch.

UNIVERSITY OF NORTH CAROLINA, CHAPEL HILL, N. C.

EXPLANATION OF PLATE LXIII

Fig. 1. The tip of a main hypha showing the gnarled condition of the secondary hyphae. × 155.

Fig. 2. Main hypha showing sporangia and method of growth. × 155.

Fig. 3. Spores encysted within the thin-walled sporangium. × 700.

Fig. 4. Spores falling apart, the basal ring remaining. × 700.

Fig. 5. Usually large basal cup with a few spores still remaining in it. × 700.

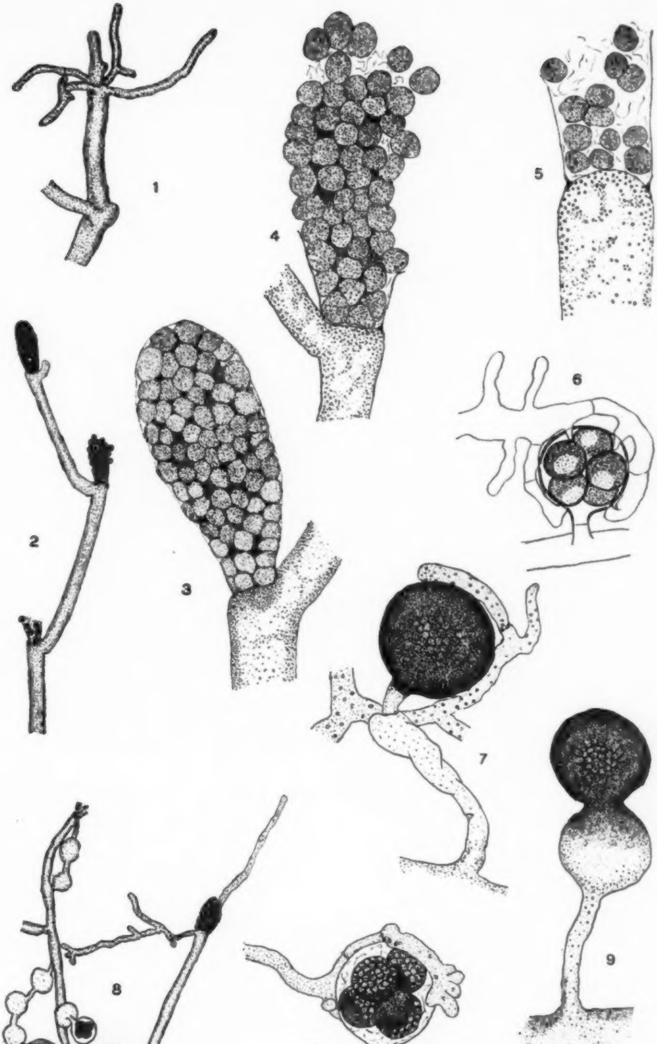
Fig. 6. Oögonium containing fully ripe eggs. Empty antheridia attached to the wall of the oögonium. × 700.

Fig. 7. Young oögonium with antheridium full of protoplasm. × 700.

Fig. 8. Showing double branching below the sporangia; antheridial branches; and new oögonia formed from old ones. × 700.

Fig. 9. New oögonium forming from old one. × 700.

Fig. 10. Oögonium with young eggs and young antheridium. × 700.



THRAUSTOTHECA CLAVATA (DE BARY) HUMPHREY

POLYPORACEAE AND BOLETACEAE OF THE PACIFIC COAST

William A. Murrill

The following list contains the species of pileate polypores and boletes collected by the writer on a recent tour of exploration through Washington, Oregon, and California. Mr. S. M. Zeller collected with me at Seattle and Tacoma; Professor L. S. Abrams assisted in exploring Preston's Ravine and La Honda. The localities and dates of the collections are as follows:

1. Seattle, Washington; virgin coniferous forests, peat bogs, and pastures. October 20–November 1, 1911.
2. Tacoma, Washington; virgin coniferous forests. ....October 26, 1911.
3. Tacoma Prairies, Washington; open barrens with clumps of young firs. October 26, 1911.
4. Glen Brook, Oregon; dense fir forests, 400–1000 ft. ..November 7, 1911.
5. Mill City, Oregon; virgin coniferous forest, 800–1200 ft..November 9, 1911.
6. Corvallis, Oregon; fir forests and mixed woods. ...November 6–11, 1911.
7. Newport, Oregon; virgin fir forest and sandy pine barrens. November 13, 1911.
8. Golden Gate Park, San Francisco, California; dry groves and shaded grassy banks. ....November 21, 1911.
9. Muir Woods, California; virgin forest of redwoods. ..November 22, 1911.
10. Preston's Ravine, near Palo Alto, California; redwoods and mixed forest up to 1000 ft. ....November 25, 1911.
11. La Honda, west slope of Santa Cruz Mountains, California; redwood forest below 1000 ft. ....November 25, 1911.

Tribe POLYPOREAE

Aurantiporellus alboluteus (Ell. & Ev.) Murrill. Found growing from the side of a decorticated red fir log, the pilei consisting chiefly of large, irregular tubes, and presenting a very different appearance from the original specimens found by Crandall inside of hollow *Abies* trunks in Colorado.
Seattle, *72*.

Bjerkandera adusta (Willd.) Karst. Found only on large-leaved maple.
Seattle, *65*, *74*.

COLTRICIA PERENNIS (L.) Murrill. Quite common in dry, sandy places in woods.

Seattle, *44;* Tacoma, *68.*

CORIOLUS ABIETINUS (Dicks.) Quél. Common on dead coniferous trunks. No trace was found of *C. prolificans,* a near relative so abundant on deciduous wood in the eastern United States.

Seattle, *71;* Glen Brook, *757.*

CORIOLUS NIGROMARGINATUS (Schw.) Murrill. Rarely seen, but abundant in places.

Seattle, *46.*

CORIOLUS VERSICOLOR (L.) Quél. Common on oak and maple in Oregon and California. Not seen at Seattle.

Corvallis, *883;* Newport, *1075;* Preston's Ravine, *1163;* Muir Woods, *1149.*

Coriolus washingtonensis sp. nov.

Pileus small, dimidiate, sessile, laterally connate, slightly decurrent behind, sometimes effuse, tough, flexible, milk-white throughout, becoming slightly yellowish above on drying, and grayish behind with age, projecting about 5 mm. from the substratum, extending sometimes 10 cm. along cracks in the bark, reaching 5 mm. in thickness behind; surface azonate, smooth, subglabrous, margin undulate or lobed, sterile, rather thick for the genus; context thin, soft, flexible; tubes 1–4 mm. long, corky, mouths regular, glistening, slightly angular, 2 to a mm., edges thin, entire; spores ovoid, smooth, hyaline, $5 \times 3.5\mu$.

Growing from crevices in the bark of a dead log of *Thuya plicata.* It somewhat resembles *Coriolellus Sepium* in shape, but the pilei are scarcely semi-resupinate, the tubes are regular, and the context is much more flexible.

Seattle, *101* (*type*).

ISCHNODERMA FULIGINOSUM (Scop.) Murrill. Found once, on a decaying red fir log.

Seattle, *102.*

LAETIPORUS SPECIOSUS (Battar.) Murrill. Collected once, on an oak log, but not uncommon on the Coast.

Tacoma, *82.*

PHAEOLUS SISTOTREMOIDES (Alb. & Schw.) Murrill. Common about coniferous stumps, springing from decaying roots.
Seattle, *77;* Muir Woods, *1137*.

POLYPORUS ELEGANS (Bull.) Fries. Common about Seattle on fallen alder branches.
Seattle, *62, 86;* Corvallis, *885½*.

Scutiger oregonensis sp. nov.

Pileus ascending, depressed behind, reniform, irregular, fleshy-tough, solitary, 15 cm. wide, 25 cm. long, 3 cm. thick behind; surface dry, dark-fulvous, uniformly and densely imbricate-floccose-scaly, the ends of the scales either slightly upturned or at an angle of 45°, margin concolorous, fertile, lobed or undulate, bay when bruised; context white, nutty, thin, fragile when fresh, with the odor of musty meal when dry; tubes white, tinged with sulfur-yellow when bruised, decurrent, mouths regular, thin-walled, 1 mm. in diameter, edges uneven, toothed; spores ovoid, smooth, hyaline, 8–10 × 5 μ; stipe eccentric, inflated, 7 cm. long, 8 cm. thick, irregular, watery-white to flavous, turning sulfur-yellow when bruised, resembling the pileus above at the point of attachment and not reticulate behind.

This large and handsome species was collected November 9, 1911, on a rocky bank among giant red firs to the north of Mill City, Oregon, at an elevation of 1,200 ft. Its nearest relative is *Scutiger retipes*, known only from Alabama, from which it differs in many important characters.

Mill City, Oregon, *847* (*type*).

Spongipellis sensibilis sp. nov.

Pileus flabelliform-conchate, narrowly attached, tough, very juicy, white throughout, changing color very quickly when bruised or on drying, about 3–4 cm. long, 6 cm. broad, and 1.5–2 cm. thick behind; surface spongy-tomentose, azonate, somewhat uneven, changing at once to melleous when bruised and at length to bay, margin entire, regular, very sensitive to handling, thin, scarcely deflexed on drying; context duplex, white, thick, azonate and friable when dry above, zonate and woody below, changing color like the surface when bruised; tubes about equalling the thickness of the context, small, at first very white and glistening, changing quickly to bay when bruised, mouths circular, even, slightly angular, friable and easily corroded on drying, 4–5 to a mm., edges very thin, long-toothed, becoming lacerate at times; spores ovoid, smooth, hyaline, 5 × 3 μ.

This species was rather common about Seattle on fallen logs and branches of red fir in moist situations. At Glen Brook, Oregon, it was found on *Abies*. When touched, it turns at once to honey-yellow and later to bay, and some color approaching bay is usually assumed by all or a portion of the sporophore on drying. Paper touching the fresh specimens is stained ferruginous and then bay.

Seattle, *43* (*type*), *54, 79, 91;* Glen Brook, *791;* Corvallis, *996.*

TYROMYCES CAESIUS (Schrad.) Murrill. On dead trunks of *Abies grandis* and other conifers.

Seattle, *70, 87.*

Tyromyces carbonarius sp. nov.

Pileus quite irregular in shape, varying from flabelliform to broadly sessile and laterally elongate, juicy, tough, fragile when dry, 1×1.5–3×0.5–1 cm.; surface tomentose to glabrous, uneven, white or hygrophanous, azonate, margin pale rose-tinted, rather thick, concolorous, narrowly sterile, undulate, rarely lobed; context white, tough to fragile; tubes equalling the thickness of the context, white within, mouths normally rather regular, subcircular, 4 to a mm., not glistening, edges white or pale rose-tinted, thin, sometimes irpiciform; spores oblong-ellipsoid, smooth, hyaline, 5×1.5–$2\ \mu$.

Collected on a burnt red fir log. The tubes may be very irregular at times, with long dissepiments, suggesting *Irpiciporus*. There is a faint roseate hue to the hymenium which is quite characteristic and rarely seen in species of this genus and its near relatives.

Seattle, *64* (*type*).

TYROMYCES CHIONEUS (Fries) Karst. Collected once, on an oak stump.

Corvallis, *904.*

Tyromyces cutifractus sp. nov.

Pileus usually broadly attached and laterally elongate, rarely flabelliform, slightly imbricate at times, 2–3.5×4–6×0.5–0.8 cm.; surface glabrous, white, often rough and unsightly because of the cracked and torn reddish-brown cuticle; context rather thick, firm, almost woody, but friable, milk-white; tubes slender, 2 or 3 times as long as the thickness of the context, white or

yellowish within and without, staining brownish when bruised, mouths glistening, small, quite regular, angular, edges entire, very thin; spores ellipsoid, smooth, hyaline, $6 \times 4 \mu$.

Type collected on a much decayed fir log in a virgin forest at Newport, Oregon. Also collected on a maple log and on the base of a living trunk of *Thuya* at Seattle. This disregard of essential differences between coniferous and deciduous wood is rather uncommon in fungi. The species is peculiar in having a brownish cuticle, gelatinous in appearance when wet, which breaks up as the pileus develops, leaving the surface very rough and unattractive in appearance, especially when plants are growing in moist situations.

Seattle, *55, 99;* Newport, *1064 (type)*.

Tyromyces perdelicatus sp. nov.

Pileus flabelliform to subcircular, varying with its position on the substratum, thin, fragile, milk-white throughout, 1–2 cm. broad; surface finely tomentose to glabrous, scarcely zonate, uneven, margin concolorous, thin, inflexed when dry; context very thin, white, fragile; tubes minute, glistening, mouths angular, subregular, edges very thin, slightly toothed, fragile; spores oblong-ellipsoid, smooth, hyaline, $7 \times 3 \mu$.

This small, snow-white species was collected several times at Seattle on fallen dead branches of conifers, and it was also found common at Glen Brook. The type specimens grew on *Tsuga heterophylla.*

Seattle, *45, 47 (type), 51, 53;* Glen Brook, *780*.

TYROMYCES GUTTULATUS (Peck) Murrill. Rare on coniferous stumps and logs. This species contains a bitter principle mi'dly resembling in taste the resin found in *Fomes Laricis.*

Seattle, *59;* Tacoma, *98*.

Tyromyces Pseudotsugae sp. nov.

Pileus imbricate-sessile, flabelliform to semicircular, $2–3 \times 2–3 \times 0.3–1$ cm.; surface milk-white, subglabrous, azonate or with zones faintly outlined, margin thin, concolorous, narrowly sterile, entire to slightly lobed, inflexed when dry; context thin, white, fragile; tubes varying greatly in length, those behind often reaching nearly 1 cm., mouths large, irregular, edges thin, fragile, toothed, collapsing, white, becoming yellowish on drying; spores ovoid, smooth, hyaline, $5 \times 3.5 \mu$.

Collected on a dead log of *Pseudotsuga taxifolia.*
Seattle, *84* (*type*).

TYROMYCES SEMIPILEATUS (Peck) Murrill. Common on fallen trunks and branches of alder and maple.

Seattle *58, 67;* Corvallis, *950;* Muir Woods, *1129;* Preston's Ravine, *1183.*

Tyromyces substipitatus sp. nov.

Pilei subcespitose, at times united above, irregularly subcircular or flabelliform, depressed, milk-white throughout, 2–4 cm. broad, 2–3 cm. high, 2–3 mm. thick; surface glabrous, uneven, lightly marked with irregular, radiating, raised lines, margin thin, concolorous, sterile, undulate or slightly lobed, slightly blackening when bruised; context fleshy, fragile when dry, very thin; tubes small, regular, fragile, collapsing, edges thin, toothed; spores ovoid, smooth, hyaline, $4 \times 2.5\mu$; stipe erect, lateral or subcentral, enlarging upward, reticulated on one side, owing to the undeveloped tubes, 1–2 cm. long, 2–4 mm. thick.

On rich soil mixed with humus, but not attached to wood. The species is aberrant, partly on account of its habit of growing upward from the ground, and might be classed with the stipitate forms of the polypores. It is closely related, however, to *Tyromyces semisupinus,* and may as well be placed in that genus as in any other.

Seattle, *75* (*type*).

Tribe FOMITEAE

CRYPTOPORUS VOLVATUS (Peck) Shear. Frequent on dead coniferous trunks.

Seattle, *80;* Glen Brook, *792;* Golden Gate Park, *1106.*

ELFVINGIA MEGALOMA (Lév.) Murrill. Common and abundant in every locality visited, usually on oak logs and stumps.

Seattle, *49;* Tacoma, *94;* Corvallis, *1001, 1008;* Muir Woods, *1151.*

FOMES ANNOSUS (Fries) Cooke. Found several times on logs and stumps of red fir. It is probably common on conifers but difficult to find because inconspicuous and often hidden.

Seattle, *89, 93;* Newport, *1089.*

Fomes Laricis (Jacq.) Murrill. On fallen, much decayed logs of *Abies grandis*, about one-half way up from the base, at Tacoma; and growing from the center of the butt of an immense red fir log, at Mill City. Specimens from La Honda, collected by Crandall on a red fir stump, were examined at Stanford University. This species is more abundant in the far west than was formerly supposed.

Tacoma, *95*, *104*; Mill City, *817*.

Fomes roseus (Alb. & Schw.) Cooke. Very common on coniferous trunks, the sporophores sometimes reaching a foot in diameter.

Seattle, *60*; Corvallis, *917*; Newport, *1046*.

Fomes ungulatus (Schaeff.) Sacc. So abundant everywhere on coniferous trunks that only one collection was made.

Seattle, *85*.

Porodaedalea Pini (Thore) Murrill. Frequently found on red fir, and doubtless occurring on other conifers. The specimens from Glen Brook grew on a living red fir trunk over six feet in diameter.

Seattle, *90*; Glen Brook, *786*; La Honda, *1298*.

Pyropolyporus igniarius (L.) Murrill. Common on trunks of living willows at Tacoma.

Tacoma, *100*.

Tribe AGARICEAE

Gloeophyllum hirsutum (Schaeff.) Murrill. Found rarely, on dead conifers.

Seattle, *50*, *61*.

Lenzites betulina (L.) Fries. Found once, on a dead oak limb ten feet from the ground.

Preston's Ravine, *1181*.

Family **BOLETACEAE**

Boletus Lakei sp. nov.

Pileus convex, often becoming plane, gregarious or subcespitose, rarely solitary, 8–12 cm. broad; surface fulvous with latericeous tints, appearing testaceous, densely imbricate-floccose-

scaly, owing to the rupture of the cuticle; margin white, sterile, entire, involute when young; context sulfur-yellow, unchanging or turning slightly yellowish-green when cut, with pleasant odor and mild flavor; tubes large, decurrent, elongate near the stipe, flavous when young, dark dirty-flavous with a greenish tint when older, unchanging when bruised; spores oblong-ellipsoid, smooth, yellowish-brown, $8.5–10.5 \times 3.5\mu$; stipe subequal, 7×2 cm., flavous at the apex, then testaceous, then adorned with the ample, white, persistent, cottony annulus, and below this similar to the pileus in color and surface markings.

This species is similar to *B. luteus* and takes its place in the flora of the Pacific Coast; but the tubes are larger and the surface is floccose-scaly. At Corvallis it was very abundant in fir woods mixed with a few deciduous trees. It gives me pleasure to dedicate this handsome species to Professor E. R. Lake, of the Oregon Agricultural College, who some time ago sent me specimens for determination collected by him at Corvallis, November 29, 1907. This type collection was accompanied by notes and an excellent photograph.

Seattle, *113;* Glen Brook, *781;* Corvallis, *933, 999;* La Honda, *1293.*

CERIOMYCES COMMUNIS (Bull.) Murrill. Common about Seattle, but rare in other localities. Several varieties were found.

Seattle, *107, 115;* Mill City, *871;* Newport, *1084;* La Honda, *1295.*

Ceriomyces mirabilis sp. nov.

Pileus convex, spongy, solitary or gregarious, reaching 12 cm. in diameter; surface moist, bay, uniformily covered with conspicuous, projecting, conic, floccose, persistent papillae, which give it somewhat the appearance of bread-fruit; margin projecting like the eaves of a house, showing a yellow membrane 2–3 mm. wide; context citrinous, slowly changing to incarnate when bruised, very watery, drying with difficulty, tasteless; tubes large, greenish-yellow, uneven; spores fusiform, smooth, ochraceous-mellous, $19 \times 7\mu$; stipe very bulbous, solid, bay and streaked below, strongly reticulate and latericeous above, the apex colored like the tubes, 15 cm. long, 1.3 cm. thick above, 3.5 thick below.

This remarkable species was found several times in the vicinity of Seattle on the ground in woods. It is one of the most difficult

species to preserve, owing to its extremely juicy consistency. It differs from nearly all other boleti in its floccose covering, which resembles that found on the surface of *Boletellus Ananas* and *Strobilomyces strobilaceus,* but the scales are more rigid and conic in shape. The collector may readily distinguish it from these two species by its bay color and the absence of a veil. Both of the other species mentioned possess a conspicuous veil, and the former is tan to brown with a pinkish tint, while the latter is dark-brown or black. Mr. Zeller has photographed this species for me, and Mrs. Murrill made a very accurate colored sketch of it.

Seattle *106* (*type*), *108, 109.*

Ceriomyces oregonensis sp. nov.

Pileus convex, firm, solitary, 12 cm. broad; surface bay, even, not viscid, short-tomentose to subglabrous, 12 cm. broad, margin entire or slightly lobed, scarcely projecting: context firm, white, unchanging, mild, odor not characteristic; tubes very large, 2–3 mm. in diameter, depressed and radially elongate about the stem, ventricose, flavous to dull greenish-yellow, melleous within, not changing when bruised; spores oblong-ellipsoid, smooth, melleous, $10–12 \times 4\mu$; stipe larger below, solid, white within, glabrous, not reticulate, very pale bay, 6.5 cm. long, 2 cm. thick at the center.

This species was collected on the ground in sandy pine barrens on the immediate coast at Newport, Oregon. Although growing in sand, the weather conditions were very humid.

Newport, *1039* (*type*).

CERIOMYCES VISCIDUS (L.) Murrill. Collected once, in sandy pine barrens. Very large, with bay-fulvous cap and rough, shaggy stem, flavous at the base.

Newport, *1099*.

Ceriomyces Zelleri sp. nov.

Pileus convex, firm, gregarious to subcespitose, 7–9 cm. broad; surface dry, uneven, bay, covered with a delicate bloom which disappears with age; margin regular, concolorous, somewhat projecting; context firm, cremeous, unchanging, drying easily, mild and slightly mucilaginous to the taste; tubes irregular, of medium size, pale-yellow to greenish-yellow, scarcely changing when

bruised; spores fusiform, smooth, ochraceous, averaging $12 \times 4.5\,\mu$; stipe bulbous, solid, red to purple, white or yellow at the base, more or less striate, furfuraceous, about 5 cm. long and 1.5 cm. thick.

This species was very common about Seattle, on rather dry banks in woods. When fully mature, the bloom on the cap disappears and the color is so dark that the sporophore is difficult to see unless a glimpse of the yellow hymenium is obtained. Mr. S. M. Zeller discovered the first specimens (No. 105), and I take pleasure in dedicating the species to him. Mr. L. S. Abrams found a number of specimens when we collected together at La Honda.

Seattle, *105* (*type*), *110, 111;* La Honda, *1299.*

ROSTKOVITES GRANULATUS (L.) Karst. Common at Newport in pine barrens, where both light and dark forms were found.

Tacoma Prairies, *114;* Newport, *1073;* Golden Gate Park, *1122.*

SUILLELLUS LURIDUS (Schaeff.) Murrill. Common under oaks on the edge of a lake near Tacoma. The form is perfectly typical, with lurid cap and red-dotted stem. Some of the caps are rimose-areolate above, much resembling *Ceriomyces communis.*

Tacoma, *112.*

NEW YORK BOTANICAL GARDEN.

NEWS AND NOTES

A new tropical laboratory for botanical and zoological research is soon to be established at Mayagüez, Porto Rico, with Dr. F. L. Stevens as director.

F. Guéguen, in *Comptes Rendus,* suggests that certain bodies found on the hyphae of a new species of Mucor are organs for the elimination of metabolic products.

In Publication 1 of the Botanical Society of Western Pennsylvania, D. R. Sumstine gives a list of eighty of the more conspicuous fungi collected within the limits of Pittsburg.

An article on nut diseases, by M. B. Waite (Proc. Am. Pomol. Soc. 182–190. 1911), treats several serious diseases of nut-bearing trees and suggests methods of control. Diseases of the pecan receive special attention.

Dr. P. Spaulding, of the division of Forest Pathology at Washington, has published a bulletin dealing in a very thorough manner with the life history of *Lenzites sepiaria* and its effects on timber. Under preventive measures, he recommends seasoning, floating, and infiltration with poisonous chemicals.

Dr. C. H. Kauffman has published in the Thirteenth Report of the Michigan Academy of Science, 1911, some very useful keys to the common genera of basidiomycetes and ascomycetes. His list of unreported Michigan fungi is also continued as in previous years.

The leaf-spot of orchids (*Hypodermium*), which begins at the apex of the leaf and gradually works downward until the entire leaf is killed, may be checked, according to F. T. Brooks, by

sponging the leaves with a dilute solution of potassium permanganate.

Mr. J. B. Rorer, mycologist of the Board of Agriculture, Trinidad, recently published an attractive illustrated annual report, treating several important tropical plant diseases and containing a preliminary list of Trinidad fungi, to which additions will be made from year to year.

An extremely handy volume by A. D. Selby on plant diseases, consisting of a general treatment, a special part on Ohio plant diseases, and a classified bibliography, has just come to us as Bulletin 214 of the Ohio Agricultural Experiment Station.

The commonest cause of the production of cancerous swellings known as "burs" on the trunks of rubber-trees (*Hevea*) in the Federated Malay States, according to Bancroft, is the wounding of the cortex by cart wheels and in other mechanical ways. Another cause seems to be the irritation from buds failing to develop into shoots. In this connection, the effect of insect work on the trunks of various trees might be investigated.

Professor J. C. Arthur and Dr. F. D. Kern spent the first week in January at the Garden consulting the mycological herbarium and library, and reading the final proof sheets of their next contribution to the literature of plant rusts, shortly to appear as volume 7, part 3, of NORTH AMERICAN FLORA.

The meeting of the various scientific societies of the country at Washington during Christmas week was a notable one and well attended. The botanists had very full programs, as well as a dinner and a smoker, in which between one hundred and two hundred took part. The Garden was represented by Dr. N. L. Britton, Dr. W. A. Murrill, Professor R. A. Harper, and Mr. A. B. Stout. A movement to unite all American botanical associations under the Botanical Society of America was auspiciously

inaugurated. The next meeting of the societies will be held in Cleveland; and the one following in Atlanta.

The pathological exhibits at the Washington Meeting were of great interest, and the room was an excellent meeting-place for botanists of all classes. The tables and walls were filled with specimens, cultures, charts, photographs, and colored drawings. Undoubtedly, this feature will require next year a larger room, with more chairs and tables, for the use of those desiring to make a careful study of the exhibits. It will also, let us hope, have a central location as it did this year, and be freely used by botanists at all times while the meeting is in progress.

The Swedish mycological Nestor, Professor Doctor Hampus von Post, died at Upsala, August 16, 1911, nearly 89 years of age. As is well known, he was one of the most diligent and assiduous contributors of Elias Fries. Not a few of the new species described in Fries' later works were detected and distinguished by him, and quite a number of Fries' Icones, both published and unpublished, were originally drawn by this "felicissimus fungorum investigator," who continued every year, even after Fries' death, and as long as his health and energy permitted, to collect, describe and illustrate species, varieties, and forms of the fungi growing around the agricultural college of Ultuna, where he was engaged during about 30 years. This accumulated work, of which nothing has been published since long ago, will no doubt be of great interest to those who have to deal with the Swedish fungous flora and will probably be adapted to throw light upon some of the problems which hitherto have remained unsolved.—*L. Romell.*

Notes on Some Papers Presented at the Washington Meeting, December 28 and 29, 1911

"Preliminary notes on a twig-blight of *Quercus Prinus*," by Della Ingram. This is due to a fungus producing pycnidia on the dead leaves and showing the *Macrophoma* type of spores. It also attacks white oak and chestnut to some extent. The disease

has been found in Connecticut, Pennsylvania, Maryland, and Virginia.

"Large leaf-spot of chestnut and oak," by A. H. Graves. A new leaf-spot, different from the common one caused by *Septoria ochroleuca,* has been found on chestnut and red oak in the entire south Appalachian region and also in Delaware. The spots, which begin to appear in August, are often an inch or more in diameter, and show concentric rings. Forty per cent. of the leaves are killed at times. Professor Farlow thinks the fungus is *Monochaetia Desmazierii* Sacc.

"Notes on *Cronartium ribicola,*" by P. Spaulding. The teleutospores develop in the cool weather of autumn. Inoculations have been successfully made through the different hosts. No single inspection will remove all infected trees. If this disease is present, it will save expense to destroy all affected trees at once.

"An edible smut," by Mrs. Flora W. Patterson. Under this title, *Ustilago esculenta* P. Henn., on *Zizania latifolia,* was exhibited and described. Corn smut is used in large quantities in Mexico City as an article of food. A smut on sorghum is also edible..

"The potato *Fusarium* situation in Europe and America," by W. A. Orton. The speaker described three diseases involved: a wilt due to a species of *Verticillium,* a wilt due to *Fusarium oxysporium,* and another disease apparently physiological and very imperfectly known.

"The method of distribution of the olive knot disease," by Horne, Parker, and Daines. Experiments were conducted at Fair Oaks, California. Slime from knots caused new knots on inoculation. The causative organism is *Bacterium Savastanoi* E. F. Smith. It is distributed on the feet of birds, and may enter leaf-scars, cracks, wound callouses, and other rough places on the trunk. Smooth-barked varieties are therefore less subject to the disease.

"Notes on some diseased trees in our national forests," by G. G. Hedgcock. Large additions were made to the hosts and distribution of many of the larger tree-destroying fungi, such as *Inonotus dryophilus, I. texanus, Pyropolyporus Everhartii, P.*

igniarius, Fomes Laricis, F. fraxinophilus, Elfvingia fasciata, and *Porodaedalea Pini.*

"Silver leaf, a disease of fruit trees," by H. T. Güssow. This disease exists from one end of Canada to the other, as well as in many parts of Europe. It is caused by *Stereum purpureum,* acting within the trunk and branches, and is probably distributed by the transportation of lumps of mycelium from one tree to another during the process of cultivation.

"Observations on the deterioration and utilization of fire-killed timber in the Northwest," by J. R. Weir. The rots of coniferous timber were chiefly discussed. The blue-staining fungus is very important in burned trunks. If the sap was ascending when the fire occurred, there is more food and more rapid fungous growth. Standing trunks have more water, which prevents access of air and consequently retards fungous attack. The reason why few fungi are found on badly burned logs is due to the fact that the organic food substances are disorganized by the intense heat. Fires are often good for forests, ridding them of fungous pests. In places on the west of the continental divide, fungous infections sometimes totalled fifty per cent. or more.

"The use of soil fungicides to prevent damping off," by Carl Hartley. For coniferous seed-beds in sandy soil, apply three-sixteenths of a fluid ounce of commercial sulfuric acid in water to a square foot of surface, and water the beds twice a day during the germination period to prevent injury from the acid. This treatment does not apply to angiosperms. Pure acid is four times as effective as commercial.

"The relative merits of lime-sulphur, lead benzoate, and Bordeaux mixture for spraying potatoes," by F. C. Stewart and G. T. French. Bordeaux mixture was found to be by far the best, preserving the foliage, prolonging the life of the plant, and greatly increasing the yield. Lime-sulphur showed a dwarfing, rather than a stimulating effect; and lead benzoate had little or no effect.

"Some wood preservations, with special reference to their toxic properties," by C. J. Humphrey. Creosote is being thoroughly investigated at present, cultures of *Fomes annosus* being used to determine its toxic effects. Of the five fractions in creo-

sote, the middle ones are by far the most toxic. Common salt is an excellent preservative for inside timbers, where leaching is impossible.

"Experiments in the use of asphaltum and other substances as dressings for wounds of trees," by John Boddy. Lead paint has been tried thoroughly and found unsatisfactory unless applied at least once a year. Coal tar, the substance most used at present, has a caustic effect on the cambium and is also less durable than supposed. Asphaltum, or pure bitumen, derived from petroleum, is the very best dressing for trees of all kinds. It is applied hot from a kettle, as in the case of street-paving.

"The importance of sanitation in the control of certain plant diseases," by L. R. Jones. It is possible that we depend too much on spraying, to the neglect of sanitation. Diseases of cabbage were used in illustration. If the "yellows" (*Fusarium*) appears in a field, it rots all the heads and there is no chance of growing cabbage in that field even six years afterwards. The only hope is in one variety which appears resistant. Another field may show only "wilt" (*Phoma*), and still another only the common "black rot." Each disease is introduced locally and remains. Fields must be kept free of these diseases, and change of crops must be resorted to if necessary.

"The effect of *Gymnosporangium* upon the transpiration and photosynthesis of apple leaves," by H. S. Reed and J. S. Cooley. The authors reported quantitative experiments upon the transpiration and photosynthesis of healthy and diseased leaves. Transpiration records were taken in the field and photosynthesis records were taken in the laboratory by use of Ganong's photosynthometer. Both agreed in showing diminished activity on diseased leaves.

"The toxicity of plant acids and enzymes," by M. T. Cook and J. J. Taubenhaus. Laboratory experiments with picked fruits are not conclusive, owing to the fact that the enzymes which guard against fungi in the field may die after picking. For example, pears may contain living enzymes 45 days after picking, while in apples the death of the protecting enzymes may occur much sooner.

"A study of protoplasmic movements in fungi," by F. M. Andrews. The slow oscillations of the protoplasm in the aerial filaments of certain moulds grown in gelatin cultures were subjected to variations in heat and light and the influence of various gases and solutions. The transpiration optimum was found to be 23–26° C. Pure hydrogen gas, cold, darkness, glycerin solution, etc., caused the movements to gradually cease.

"Cardinal temperatures for germination of uredospores of cereal rusts," by E. C. Johnson. The optimum for *Puccinia graminis* and five other species was found to be 12–17° C. Higher temperatures retarded germination, hence there is less development in spells of hot weather. Professor Arthur would like to know why teleutospores will not grow. Out of 137 species, material of which seemed to be in perfect condition, he succeeded during one season in germinating only 37 for purposes of inoculation.

W. A. Murrill.